VOLUME XLVIII NUMBER THREE

THE NATIONAL GEOGRAPHIC MAGAZINE

SEPTEMBER, 1925

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TO carry out the purposes for which it was founded thirty-seven years ago, the National Geographic Society publishes this Magazine. All receipts are invested in the Magazine itself or expended directly to promote geographic knowledge.

ARTICLES and photographs are desired. For material which the Magazine can use, generous remuneration is made. Contributions should be accompanied by an addressed return envelope and postage.

IMMEDIATELY after the terrific eruption of the world's largest crater, Mt. Katmai, in Alaska, a National Geographic Society expedition was sent to make observations of this remarkable phenomenon. Four expeditions have followed and the extraordinary scientific data resulting given to the world. In this vicinity an eighth wonder of the world was discovered and explored—"The Valley of Ten Thousand Smokes," a vast area of steaming, sprouting fissures. As a result of The Society's discoveries this area has been created a National Monument by proclamation of the President of the United States.

AT an expense of over $50,000 The Society sent a notable series of expeditions into Peru to investigate the traces of the Inca race. Their discoveries form a large share of our knowledge of a civilization waning when Pizarro first set foot in Peru.

THE Society also had the honor of subscribing a substantial sum to the expedition of Admiral Peary, who discovered the North Pole.

NOT long ago The Society granted $25,000, and in addition $75,000 was given by individual members to the Government when the congressional appropriation for the purpose was insufficient, and the finest of the giant sequoia trees of California were thereby saved for the American people.

THE Society is conducting extensive explorations and excavations in northwestern New Mexico, which was one of the most densely populated areas in North America before Columbus came, a region where prehistoric peoples lived in vast communal dwellings and whose customs, ceremonies, and name have been engulfed in an oblivion.

THE Society also is maintaining expeditions in the unknown area adjacent to the San Juan River in southeastern Utah, and in Yunnan, Kweichow, and Kansu, China—all regions virgin to scientific study.

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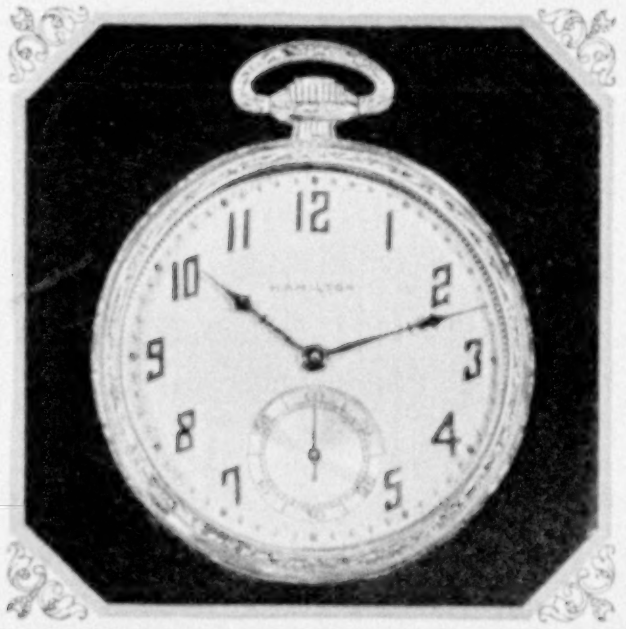

At left—the new Masterpiece design. Hamilton pocket watches may be had in yellow, white or green gold, 14k or filled, plain or engraved. Prices $48 to $250. You can choose from a wide variety of cases and dials.

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THE FOLLY of UNSELLING

¶ If a man truly deserves a high destiny, he will attain it. Time spent trying to thwart him is worse than waste time because it corrodes the spirit of the one who makes the attack. Effort against another rarely succeeds unless that other has already failed. ¶ If your adversary is vulnerable it is permissible perhaps to press home your own superiority. ¶ But, again, if he deserves and is deserving of his high destiny—you wound yourself when you seek to injure him. ¶ There are those men, and those artistries, and those business institutions, which never relax their integrity and never lose their title as leaders. ¶ They do not lose their leadership because they strive with mind, heart and soul to continue to deserve it. ¶ Wise men do not waste time tilting at such high peaks as these. ¶ More especially, wise men do not seek to alienate the millions who have bestowed the leadership. ¶ When men in the mass have conferred fame and glory upon a name, it becomes in a sense their name, and they guard it jealously. ¶ They are, as we say in the colloquialism of commerce, 'sold' on that name; which means that they believe in it implicitly. ¶ And, of all the follies of selling, there is no greater folly than that of seeking to unsell that which is well and truly sold in the minds of men. ¶ Unselling fails a thousand times where once it wins a hollow victory. ¶ It delays, and distracts, and stirs up the muddiest depths of anger and envy. It poisons the sources of mental and creative activity and diverts them from their honest and healthful purposes. ¶ The excitement and the enthusiasm it engenders in the salesman who has undertaken the thankless task is a false and artificial emotion, born of unworthy motives. It punishes him whose one desire is to inflict punishment. ¶ Meanwhile, the man, or the thing, or the business house, of high destiny goes on unperturbed. ¶ If that destiny is deserved, it will be attained and maintained.

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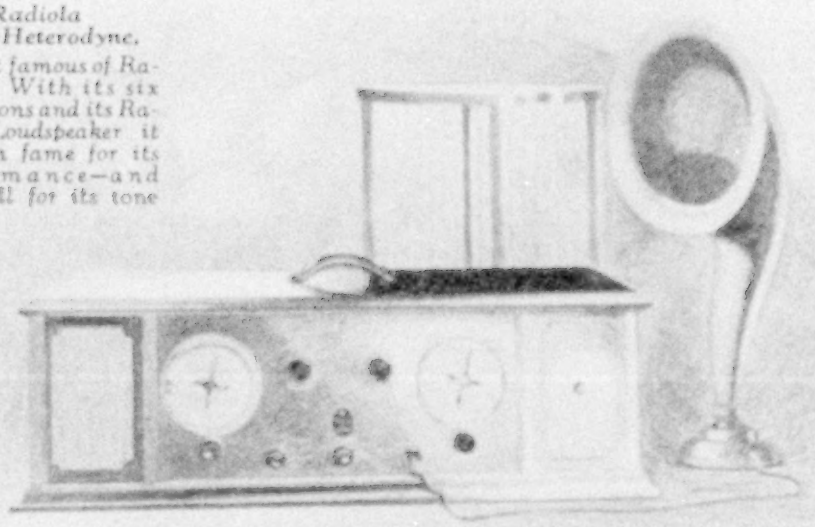

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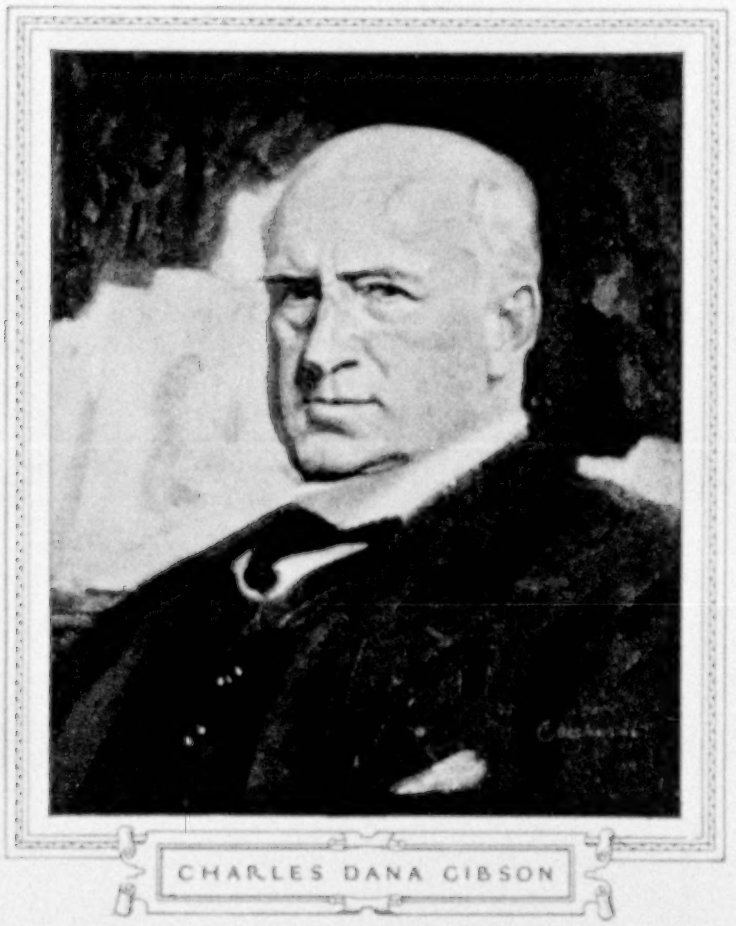

CHARLES DANA GIBSON

Painted from life by
WM. OBERHARDT

My paragon of punctuality··keeping time as accurately as the Gray-Beard with the Scythe

One of a series of little biographies of Elgin Watches

WRITTEN BY EMINENT ELGINEERS

* * *

Gentlemen who make pictures and books and plays and such things for the divertissement of their fellows, are not supposed to work by the watch.

But even an artist has appointments to keep, orders to fill, and the 5.15 to catch. And if he is habitually late for dinner, the cook will not stay.

For many years, I might have been known as a "two watch man." I carried an opulent, turnip-shaped watch bequeathed to me by an ancestor — and another given me by an associate. Between the two, by checking one against the other and striking a happy mean, I managed to secure a fair approximation of the time.

But one day, it dawned on me that it might not be economic wisdom to use two implements for the work of one. So I secured an Elgin—which has since become my paragon of punctuality —keeping time as remorselessly and accurately as the Gray-Beard with the Scythe.

by CHARLES DANA GIBSON

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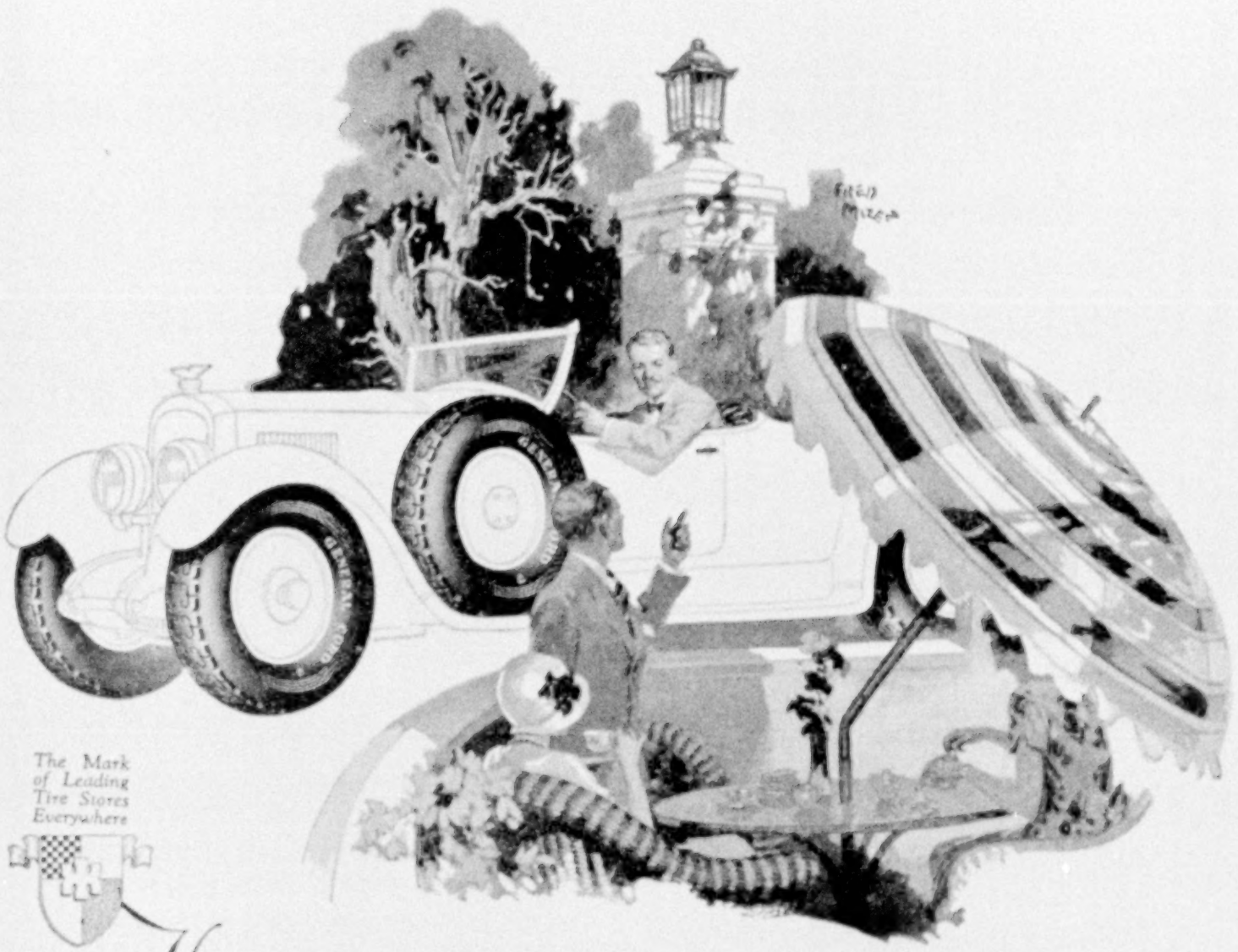

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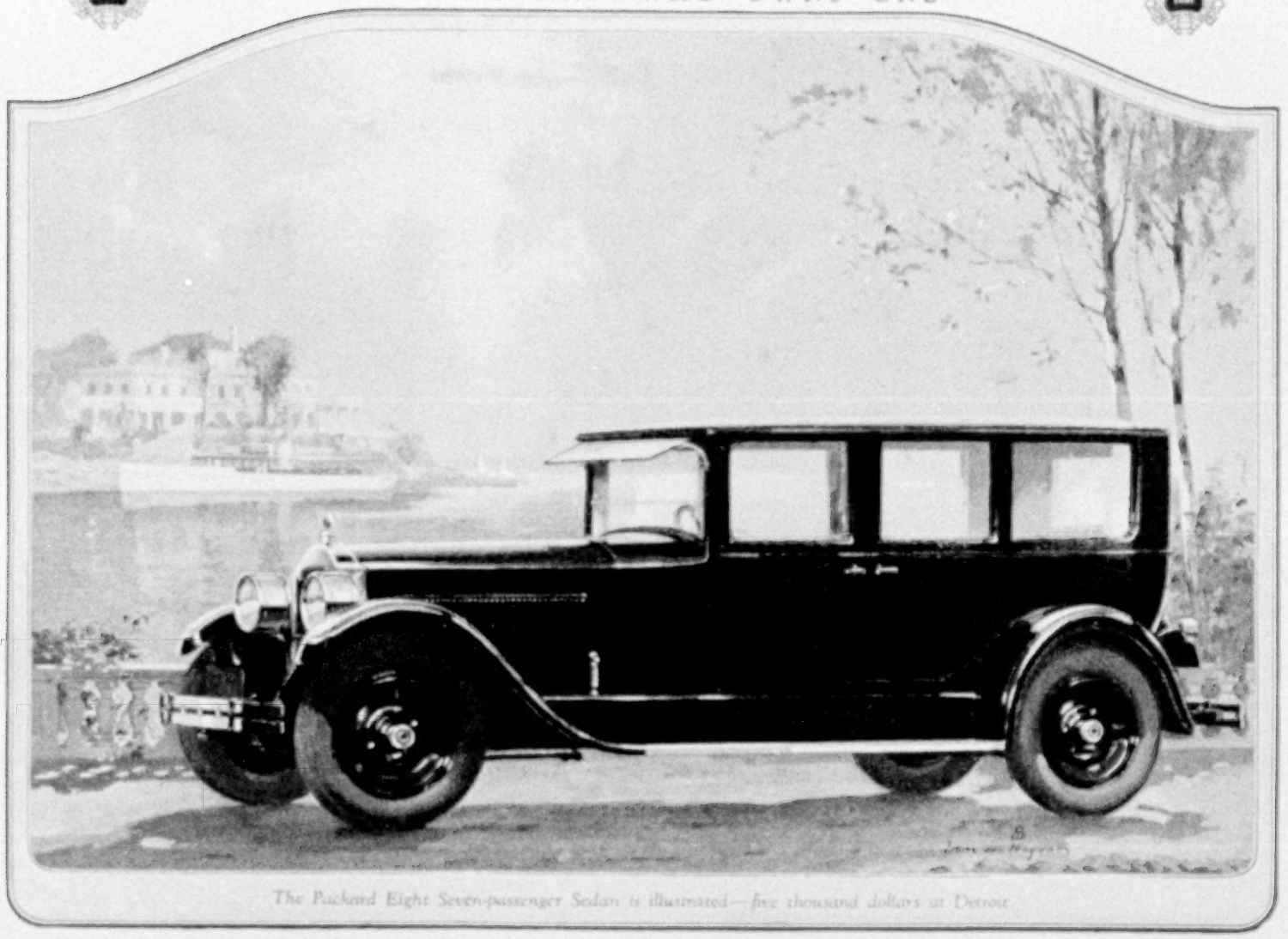

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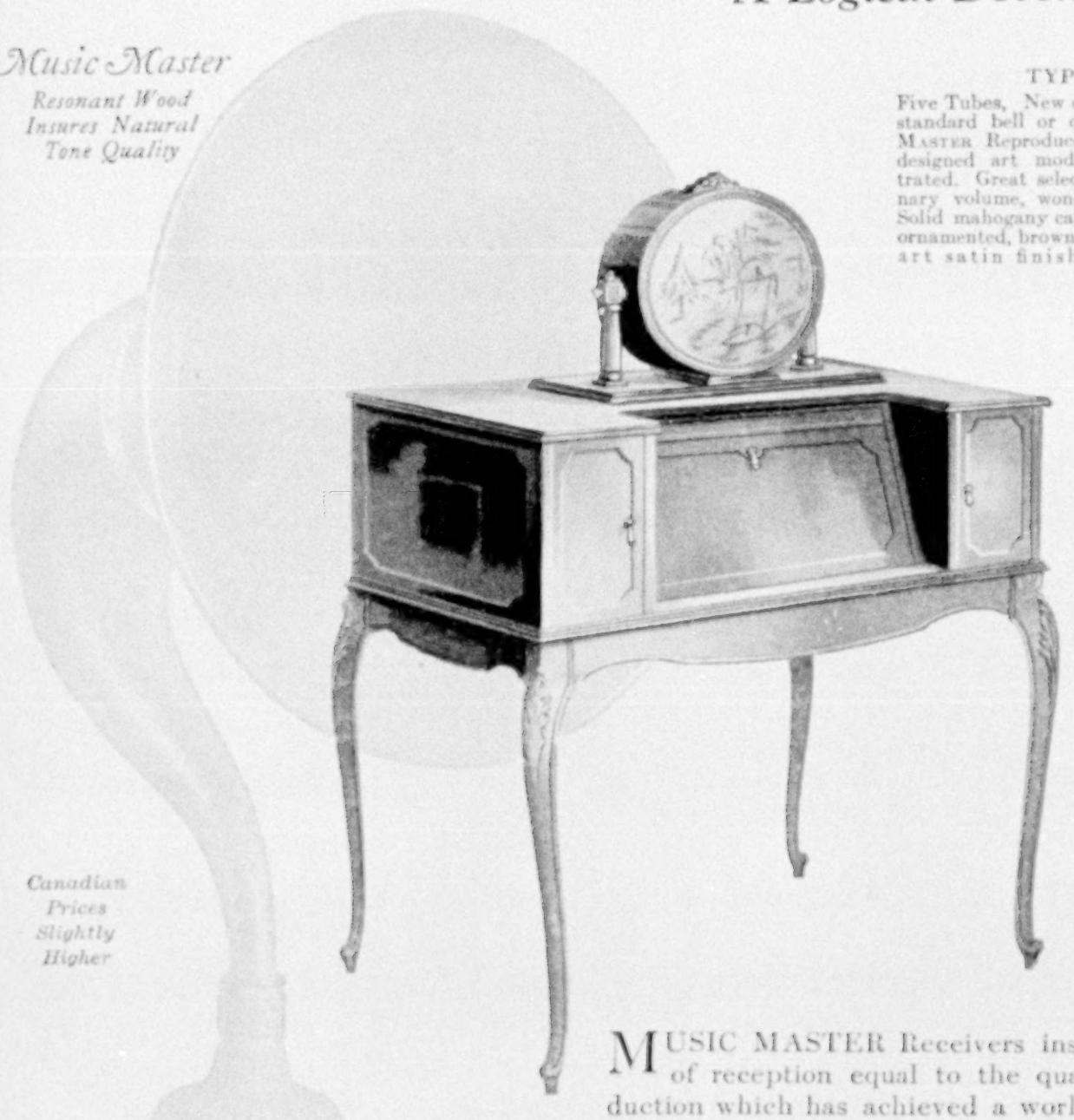

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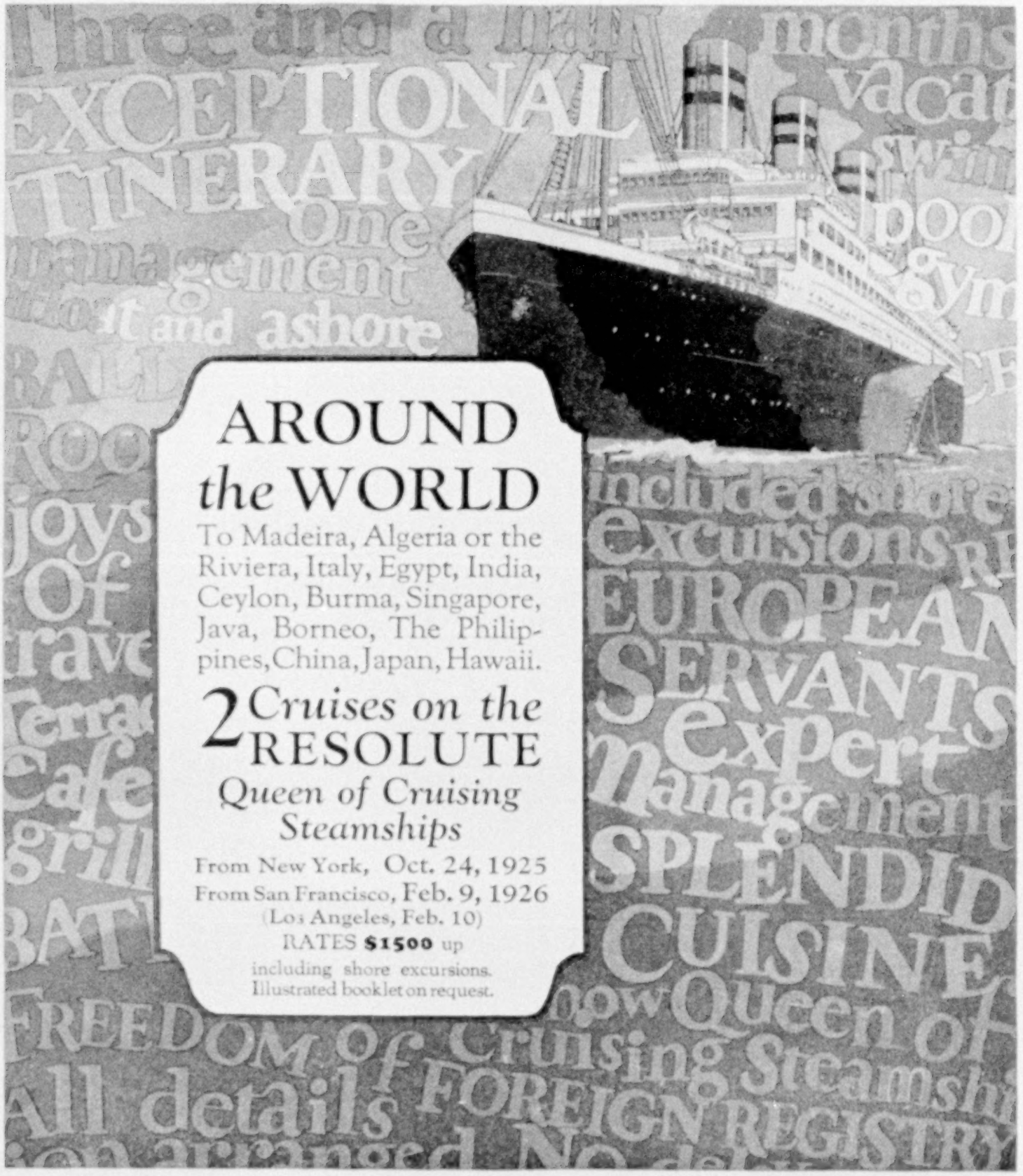

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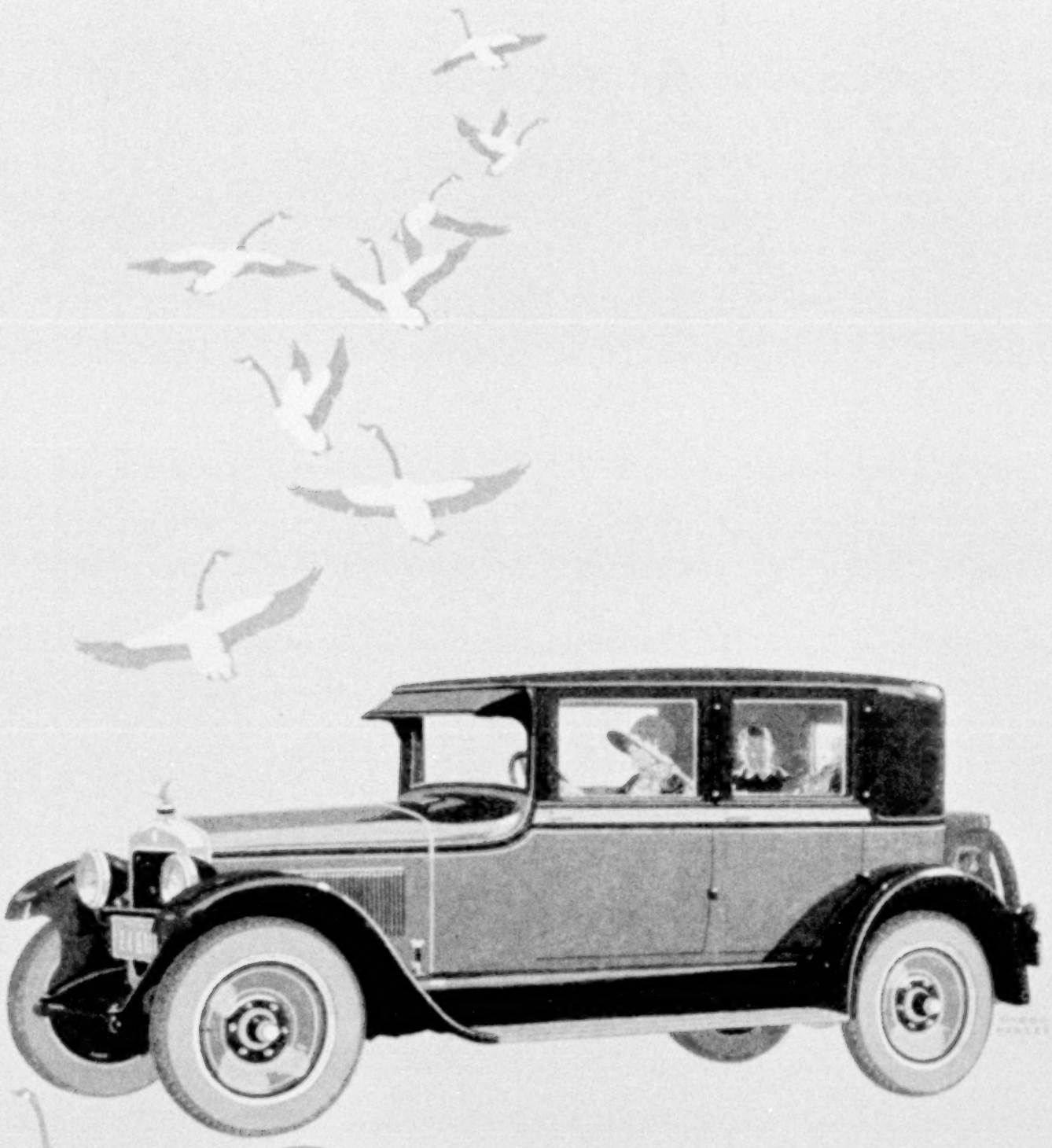

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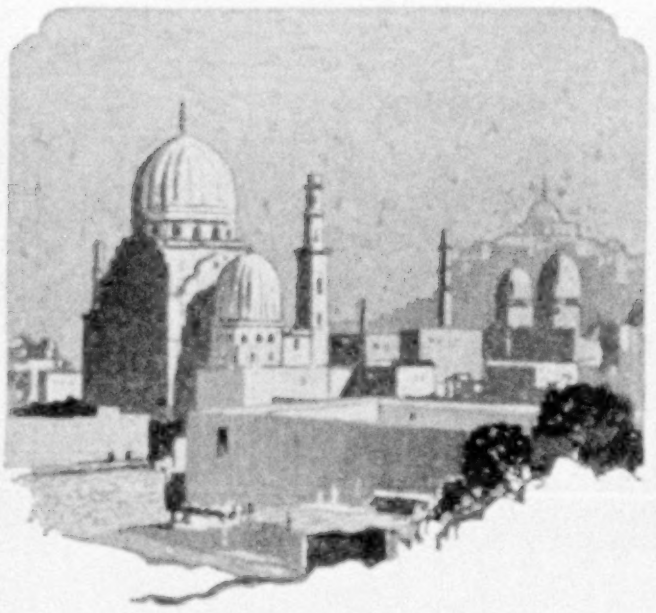

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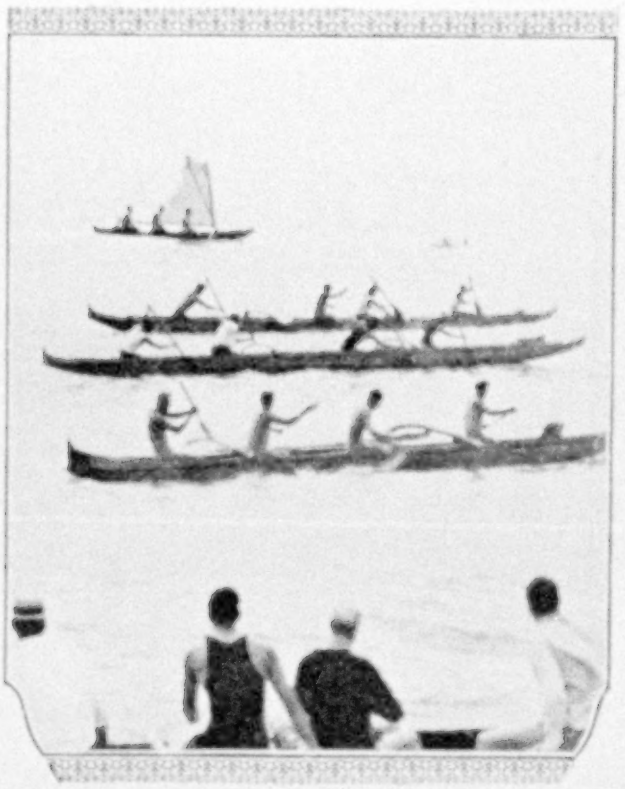

dreamy *Autumn* holidays *in* Hawaii

When the children are in school, why not take *your* holiday this fall? A gorgeous vacation in the Paradise of the Pacific, in the months between now and Christmas!

Strange as the outrigger canoes that race like long-legged waterflies at Waikiki, Hawaii is a territory of the United States with modern conveniences at moderate prices.

Long autumn days, sunny yet cool, to enjoy golf, polo, motoring, tennis, county fairs, swimming meets, surfing, inter-island cruising, deep-sea fishing. Tropic fruits, fragrant flowers and Hawaiian music. Hawaii National Park's volcanic wonderland is especially attractive in autumn.

Enjoy it longer

Plan to stay longer than the one or two weeks which a round trip of 3 or 4 weeks from the Coast allows. But the latter, costing as little as $300 or $400 for all expense including first-class travel and accommodation ashore, will give you a taste of Hawaiian enchantment.

Your nearest railway, steamship or travel agent will book you direct via Los Angeles, San Francisco, Seattle, Vancouver or Victoria, B. C. You'll enjoy the 5 or 6 days voyage to Honolulu on stately liners. Ample modern hotels on 4 larger islands.

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WITH most of us it is a matter of real regret that we do not read the Bible more. We realize that here are unparalleled treasures of religious and secular thought, the mightiest of inspirational truths, the finest glories of literature. But hitherto in our reading we have stumbled over obscured passages, over seeming discrepancies.

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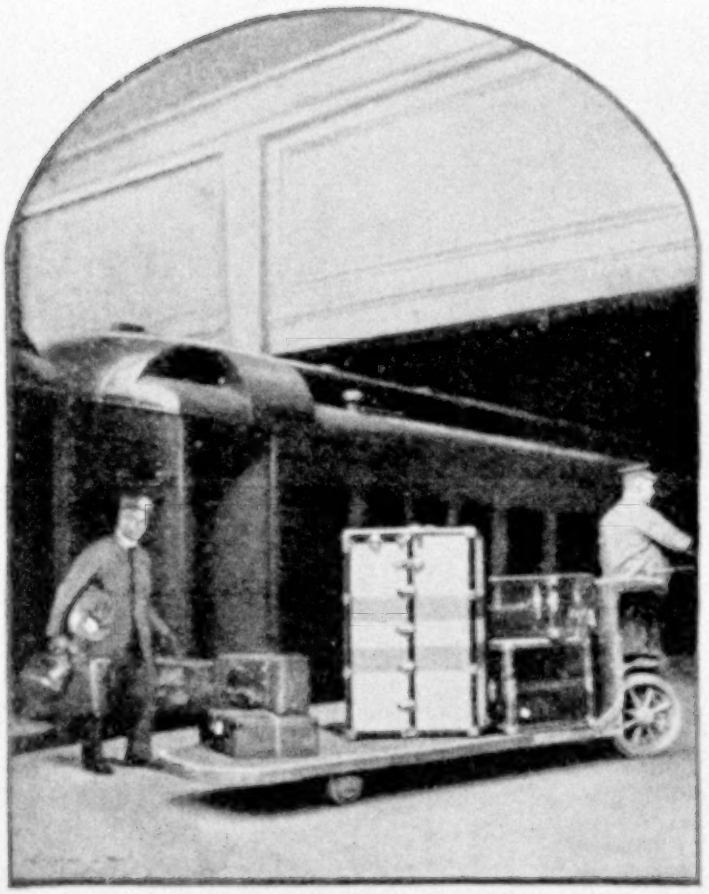

THE RAILROADS have become bigger, but by no means gentler. Through the buffets of their increasing traffic, the greatest trunk line is still Oshkosh.

An attractive booklet describing Oshkosh Trunks will be sent you on request to 445 High Street Oshkosh, Wisconsin.

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Oshkosh, Wisconsin, and New York City

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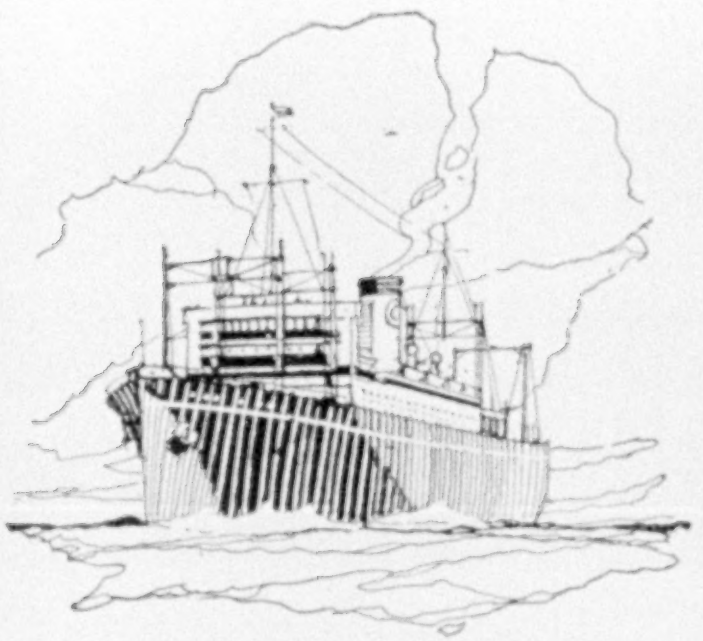

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The big pencil with *the* easy grip *and the* big smooth-writing lead

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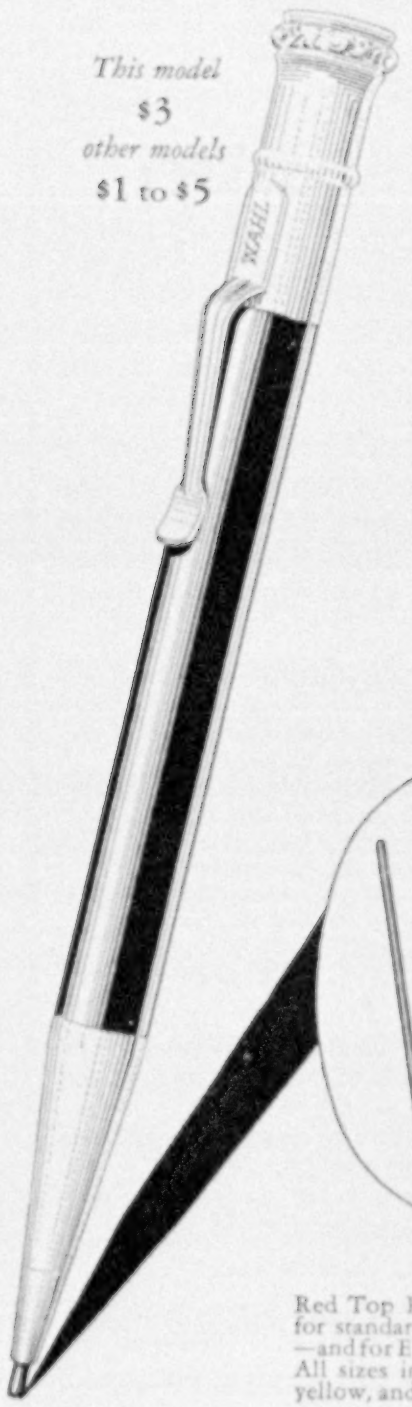

This model
$3
other models
$1 to $5

EVERSHARP "75" is the name of a new series of Eversharps using leads almost twice the thickness of those carried by the standard Eversharp.

You will like this big, smooth-writing lead. And Eversharp "75" is made in large barrel models—a big pencil as well as a big lead.

The big pencils have all the Eversharp features, including the famous, patented, rifled tip which holds the lead firmly *at the point,* so it cannot wobble or turn. They are obtainable in black, red, or mottled, with gold trim, at $3—in black or red, nickel trim, at $1. And all are handsome.

Regular model Eversharps with the new thicker lead complete the "75" family. Try the Eversharp "75" at your dealer's.

Wahl Eversharp and Wahl Pen
Made in U. S. A. by THE WAHL CO., Chicago
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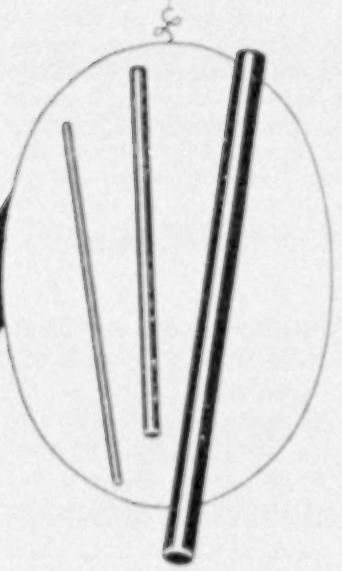
Prices same in Canada as U. S.

Standard Model

Desk Model

Standard model Eversharps in regular designs and barrel size, but equipped with the "75" thick lead—$1 to $5.

The desk model "75." Black or red with nickel trimmings, big barrel, and big lead. A beauty and a great value at $1.



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A Zeiss binocular purchased over 22 years ago has been the "constant companion" of Captain Amundsen on every one of his expeditions, including his discovery of the South Pole.

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> My most prized possession is my Carl Zeiss Binocular, which is just as good today as when I bought it in 1902. It has been my constant companion on every trip for the past 22 years, including my trip to the South Pole. It has withstood every known climatic condition and very severe use. I do not hesitate to recommend Zeiss Binoculars most highly.
>
> Roald Amundsen

The binocular used by Captain Amundsen and 20 other models of 3 to 18 power are shown in our complete catalog. Write us for a copy.

Zeiss binoculars are sold by leading opticians, camera and sporting-goods dealers.

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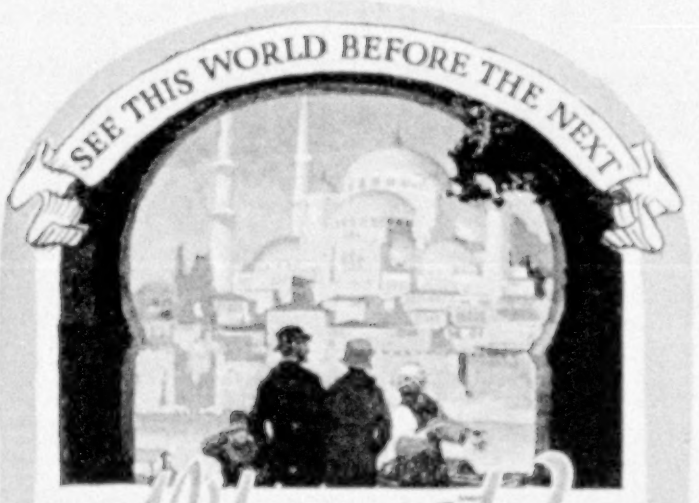
FEB. 9TH FROM NEW YORK

Mediterranean CRUISE



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-IF YOU CAN GO WITH THE WORLD'S GREATEST TRAVEL SYSTEM

And next winter—why not another step up in the field of travel? See how much this cruise crowds into 2 months. Not only sunshine! Not only pleasure! But also first-hand acquaintance with the entire Mediterranean Country....You sail on Feb. 9. In a few days, the balminess of Madeira. Then, the Mediterranean. You see the places every traveller sees,—Cadiz, Algiers, Naples, Constantinople. You discover the places most travellers miss,—Lisbon, Beirut, ancient Syracuse, and fairy-like Venice. Almost 3 weeks in the Holy Land and Egypt. 64 days in all.... Everywhere, expert guidance by Canadian Pacific's own staff. Everywhere, favored arrangements by Canadian Pacific's world-wide connections. One standard of service throughout—Canadian Pacific. And one delightful home, the Empress of France, chosen twice for voyages by the Prince of Wales....For the accommodation you wish, at the rate you wish, please reserve now.

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One management

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Just as electricity made possible the modern town, so is it now the master builder of the modern suburb, with its well-planned, well-lighted homes in the fresh air.

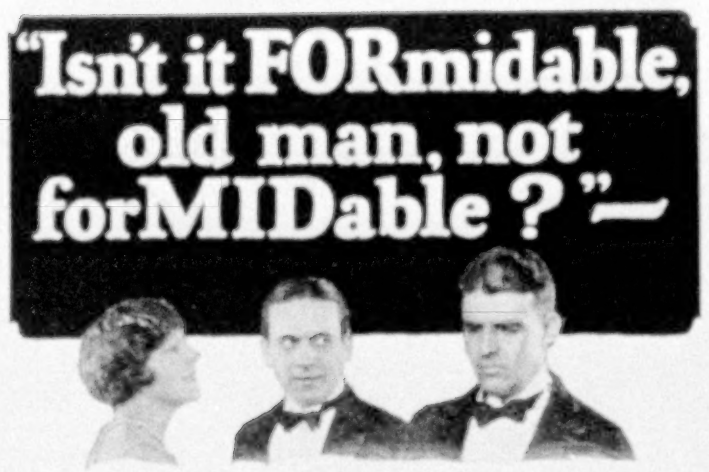
So many roads home!

Every electric railway track is the road *home* for many people.

Home nowadays need not be within walking distance of office and factory. It may be many miles away and still be served by the trolley car and all the electrical conveniences that yearly stretch further into the healthful countryside.

Electric power is the magic source that moves the trolley on our streets, that speeds on the interurban. This same wonderful energy brings light to our highways and homes and turns the wheels of all industry. Much of the equipment that enables electricity to render its efficient public service is made by the General Electric Company.

GENERAL ELECTRIC



Stop Making Embarrassing Mistakes in English

YOU are sized up every day by what you say and write. The words you use; how you use them; your spelling, grammar, pronunciation—these give others the measure of your education.

Others quite naturally think you are lacking in culture if you say "between you and I," instead of "between you and me;" if you use "who" for "whom" and "shall" for "will;" if you say "hosPITable" when you should say "HOSpitable;" or if you make similar common blunders. Fairly or unfairly, you are always mercilessly judged by the character of the English you use.

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For the first time in the history of education there is a way to improve your English quickly and surely. Sherwin Cody, perhaps the best-known teacher of practical English, has perfected and patented a remarkable device which will quickly find and correct the mistakes you unconsciously make. Correct English soon becomes a habit.

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If you are efficient in English it will give you greater confidence; if you are deficient you surely want to know it. For this reason Mr. Cody has prepared a simple 15-minute test which you can take in your own home. The correct answers are given so you can tell at once just where you stand. Write today for this test—it is free. We will also gladly mail you Mr. Cody's new free book, "How to Speak and Write Masterly English." Merely mail the coupon or a postal card. Free yourself of the embarrassing errors in English that make you feel ill at ease. You can never achieve your greatest possibilities until you do master English. Write today.

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to the Orient

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Where the world's all different, from the crown of its head—with pearls and pale flowers in a carved coiffure—to the soles of its feet in butterfly slippers. Where anything may happen—and generally does—except what happens at home.

Why stay only at home and grow old and sane and rich and unadventurous? Why not swish back the pages of a thousand years—ten thousand miles—jump clear of your world and mine? .... *You'll never be any younger!*

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On November 25th the Red Star Liner *Belgenland* sails Westward from New York on her second World Cruise of 132 days. The 475 fortunate voyagers will visit 60 cities in 14 countries—60 cities chosen because of their charm and appeal to those who would know the world—its races, customs, civilizations, beauties.

Steaming *Westward*—and in *late Fall*, in order to follow Springtime round the globe—is an all-important factor which means that each country is visited at the season best for travel there, that Cairo is reached at the height of the Egyptian season and the Riviera in time for Spring sojourns in Europe.

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the preferred train between Chicago and the Northwest. De luxe equipment and service—no extra fare. A popular way to California.

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GREAT NORTHERN

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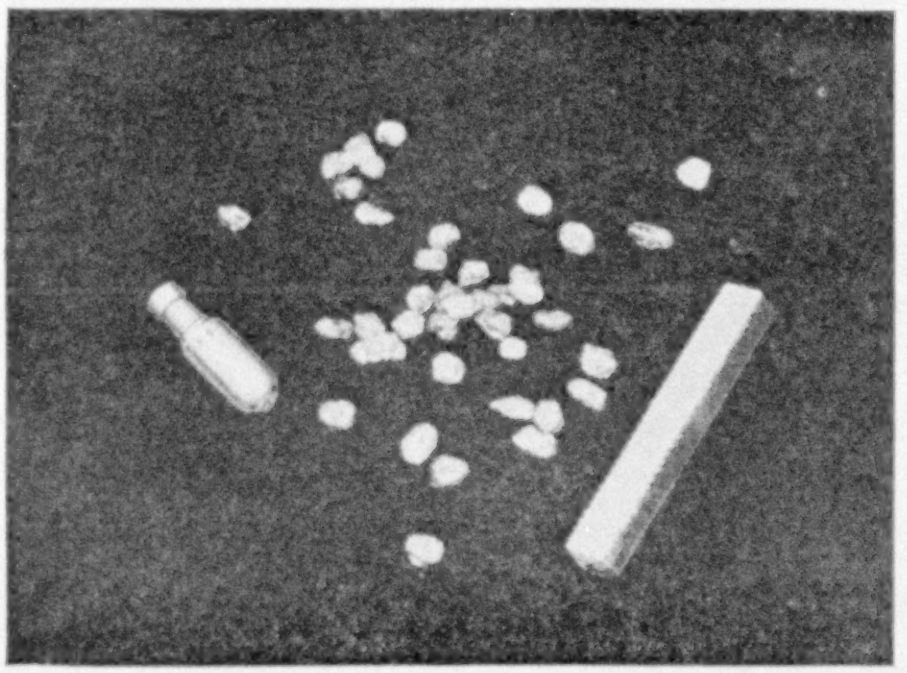
Finest Train to and from Pacific Northwest—No Extra Fare

FACTS ABOUT A FAMOUS FAMILY

A handful of uncut diamonds and two of the tools in which, after having been cut, the diamonds are set. *Below:* a workman grinding crankshafts with a wheel shaped for this exacting work by diamonds.



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Perhaps it has never occurred to you that diamonds enter into the manufacture of a motor car. They do. There are some cutting tasks which must be done so accurately that only a diamond can do them.

General Motors uses many thousand dollars' worth a year and recently its engineers have discovered a new way of setting them into the cutting tools, increasing their efficiency and reducing the annual diamond bill by half.

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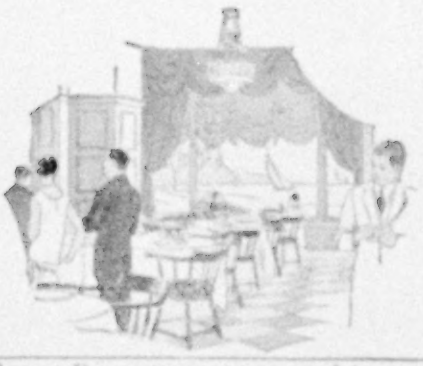
Father of Tree Surgery

Gentlemen: Without cost or obligation on my part, please have your local representative examine my trees and advise me as to their condition and needs.

The DRAKE

Upper Michigan Ave.
and Lake Shore Drive
CHICAGO

FAR-FAMED is THE DRAKE and its splendid location on the restful shores of Lake Michigan. Charming views from every window. Here you may enjoy delightful relaxation from the hurry and noise of the "loop" district—yet be almost in the heart of the city.



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The next time you buy glassware for your home, don't just ask for glassware instead insist on Heisey's ◈ glassware. It is consistently better. The Diamond ◈ on every piece is your guarantee that it is genuine Heisey's Diamond H Glassware.

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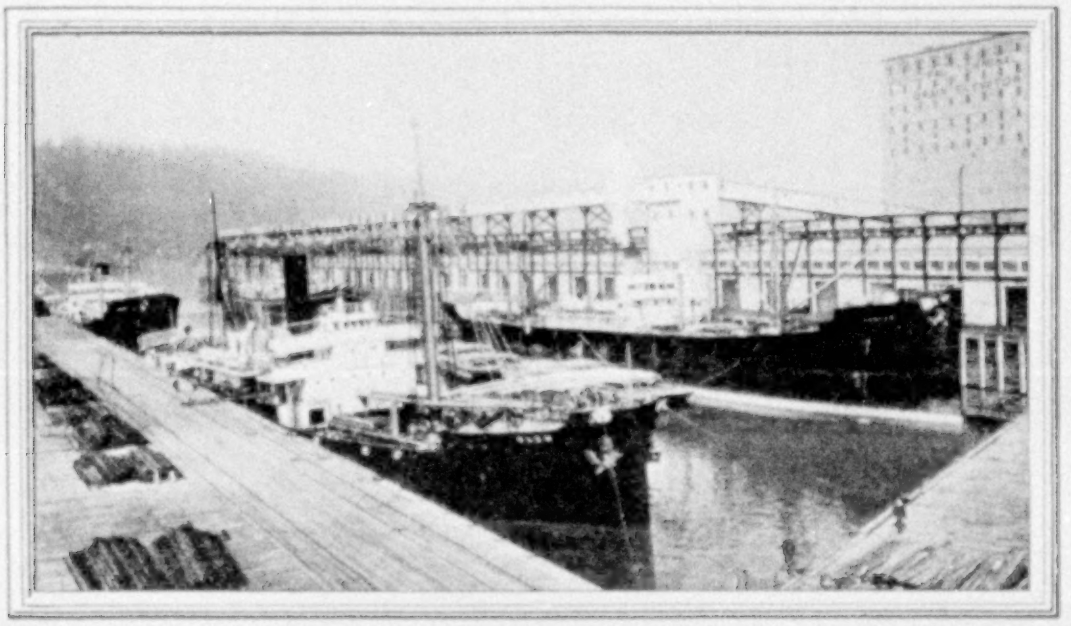
PACIFIC NORTHWEST



With healthy rivalry the seaport cities of the Pacific Northwest have vied in building port facilities that are unsurpassed in the harbors of the world

Nearer BY DAYS *to the Orient!*

Shippers save from two to ten days and thousands of dollars by routing their trans-Pacific shipments through Pacific Northwest ports.

These are the nearest American ports to the Orient. They are from 300 to 400 miles nearer by straight lines. They are nearer still by shipping lines.

Yokohama, for example, is 1179 miles nearer the Pacific Northwest because the other common trade route to our Pacific Coast is by way of Honolulu.

This means a saving of almost one-fourth of the time in shipments to and from the Orient. It means a saving in the cost of ship operation, interest charges and insurance.

This is an especially important advantage in shipments of products of high value, where large amounts of capital are tied up and interest and insurance charges are heavy.

Thus, more than 70 per cent of the raw silk imported from the Orient enters the United States through the Pacific Northwest. And 80 per cent of the trans-Pacific mail is handled through the Seattle post office.

In addition, the rail haul to the principal Eastern cities is shorter from the Pacific Northwest.

These are some of the reasons why the ports of Washington and Oregon dominate foreign trade on the Pacific Coast.

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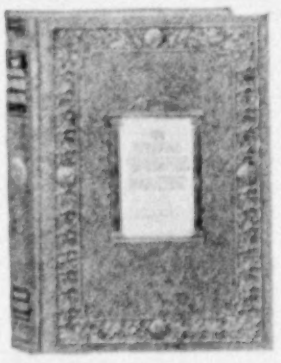

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Health Heroes

FIFTY years ago every man, woman and child in the world was threatened by lurking dangers against which there was no protection. From time to time epidemics of contagious diseases raged through communities. The doctors of those days did their best to *cure* but were largely powerless to *prevent* sickness. Small wonder that strange beliefs were associated with the prevention of diseases, the causes of which were unknown.

There is a record in an old book of English customs of many curious charms to ward off disease—powdered snake-skins to prevent typhoid; a live spider in a peach-stone basket hung around the neck as a preventive of scarlet fever; garden snails and earth-worms steeped in beer to check consumption. In our own day, some of us were told that a bag of sulphur worn on the chest would prevent diphtheria.

From Superstition to Knowledge—

Until 1876 not one doctor among thousands knew what caused contagious disease. It was in that year—less than fifty years ago—that Louis Pasteur, great French scientist, startled the world by announcing his discovery of germs as a cause of disease. It was the key to the mystery of the cause and prevention of contagious diseases.

The history of medicine from that time reads like a romance—a wonderful story of achievement, of work and struggle, disappointment and hope—and constant fight against the ignorance which cloaked diseases. In just four short years, from 1880 to 1884, were discovered the germs of pneumonia, typhoid, tuberculosis, cholera, erysipelas, diphtheria and tetanus, usually called lockjaw.

Lucky Little Girl!

Fortunate are the youngsters born in this day—whose parents can use the marvelous gifts of modern medical science to prevent sickness.

The splendid work of the Health Heroes is bringing longer, healthier, happier life to millions.

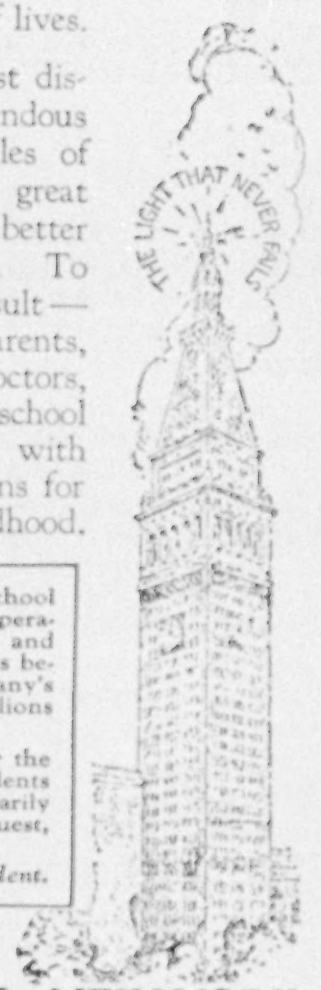
From Knowledge to Action—

Now that we know the cause and know how to fight disease, how can we best apply this knowledge to keep our children well?

The schools of the country, supplementing the work of health officers, provide a natural place for the beginnings of health education.

Cooperate with the school. Aid the teacher who is striving to interest your child in the practice of health habits. Have your child examined by your physician. Have him inoculated against the dread diseases which formerly took thousands of lives.

Every year the fight against disease goes on—a tremendous war! Every year the rules of health laid down by the great Health Heroes, are being better understood and followed. To secure the desired result—healthy boys and girls—parents, teachers, specialists, doctors, nurses, as well as the school janitor must join hands with health officers in campaigns for healthier and happier childhood.



The Metropolitan Life Insurance Company recognizing the importance of the great work that 1,000,000 teachers are doing in promulgating health practices has organized a school health bureau under the guidance of eighteen well-known educators of the United States and Canada. These men and women, as the Metropolitan's educational advisory group, are pointing the way in which the Company can best assist educators in school health campaigns.

The advisory group has approved a program which includes the printing of special booklets, leaflets, and charts for use by the teacher in class instruction. A book of instructions for the school janitor has also been prepared. Through cooperation with parents-teachers associations and women's clubs, the message of child health is being spread in many communities. The Company's agents are carrying a similar message to millions of homes.

A series of pamphlets, "Health Heroes", for the use of Junior and Senior High School students has been prepared. Although intended primarily to assist school teachers, they will, upon request, be sent to others interested in child health.

HALEY FISKE, *President.*

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Concentrated energy in chocolates exactly answers the call of that "empty feeling" that follows a round of golf, a morning in the surf, or a battle royal at tennis.

People eat far more of Whitman's Chocolates in summer than they did formerly, and for three reasons:—

They have discovered that chocolates give "pep."

Whitman's Chocolates are carefully packed and protected against summer's heat.

The exclusive plan of Whitman distribution, direct to exclusive sales agencies, even in the most remote summer resorts, assures fresh chocolates in good condition, and guaranteed.

Whenever you see the sign you know that the dealer's stock comes, not from a jobber, but direct from Whitman's. For your guests out-of-door's, supply

Whitman's
Chocolates

SALMAGUNDI
Ideal companion for "roughing it" out-of-doors. The handsome metal box gives protection to this popular assortment of Whitman's.

VOL. XLVIII, No. 3 WASHINGTON SEPTEMBER, 1925

THE NATIONAL GEOGRAPHIC MAGAZINE

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EVERYDAY LIFE IN PUEBLO BONITO

As Disclosed by the National Geographic Society's Archeologic Explorations in the Chaco Canyon National Monument, New Mexico

BY NEIL M. JUDD

LEADER OF THE PUEBLO BONITO EXPEDITIONS

EVEN in ruin Pueblo Bonito stands as a tribute to its unknown builders. It is one of the most remarkable achievements of all the varied Indian peoples who dwelt within the present United States in prehistoric times.

Pueblo Bonito is a massive communal dwelling — a village within itself — that sheltered, in its heyday, no less than 1,200 individuals. It is a broken pile of once-terraced homes that rose four stories in height and covered ten times more ground than does the White House, in Washington. It is the dead echo of an aboriginal venture in democracy that reverberated throughout our desert regions at least 500 years before Columbus set forth on his memorable journey to the New World.

The National Geographic Society began intensive exploration of Pueblo Bonito in 1921. Each succeeding summer has found The Society's representatives at work there, delving into the secrets of an ancient people who left no written record of their thoughts and experiences. A hundred thousand tons of earth and stone and blown sand have been carted away, revealing a veritable maze of empty rooms in which the former occupants unwittingly left the ineradicable thumbprints of their distinctive culture.

From these material fragments—earthenware vessels, agricultural tools, personal ornaments, and bits of ceremonial paraphernalia — we seek to reconstruct the wordless history of the now-vanished Bonitians. The records are sometimes difficult, sometimes impossible, of interpretation. Again, the story fairly flows from the specimen in hand.

THE ONLY KNOWN NECKLACE OF ITS KIND DISCOVERED

What reader, for example, fails to understand and appreciate that marvelous turquoise necklace recovered by the expedition of 1924? (See Color Plate IV and text, page 246.) Its purpose is quite manifest. The lapidarian skill of its maker, the joy and pride its original owner must have felt in sheer possession of it, are perfectly obvious.

But the reader can scarcely know that an unbelievable amount of labor went into fabrication of this prehistoric jewel; that the rough, unworked stone was obtained only at the cost of great human effort; that the 2,500 beads composing the string were made individually by rubbing small disks of matrix back and forth across sandstone tablets; that each tiny piece was drilled separately with a sharpened flint or some still more pointed instrument.

Photograph by O. C. Havens

REPAIRING THE NORTH WALL OF KIVA Q AT PUEBLO BONITO

The kivas were circular rooms, devoted to religious purposes. Ceremonial requirements placed the kivas at an elevation lower than the living rooms, for they symbolized an earlier world from which the people had emerged onto this earth (see text, pages 248 and 249).

Photograph by O. C. Havens

THE NATIONAL GEOGRAPHIC SOCIETY'S CAMP AT PUEBLO BONITO

During four months of the year this camp, although it seldom contains more than half a hundred persons, is the seventh largest settlement in San Juan County. All provisions for the camp are hauled from the railroad station of Gallup (see map, page 232), 106 miles distant, and even firewood has to be brought from 20 miles away (see text, page 230).

Nor can the average reader accurately measure the inestimable contribution The Society has made to science and history through preservation of this, the only known necklace of its kind in all the world.

Geographical exploration is not always so simple as it may appear from a printed page. Whether it be tracing a precarious path between hissing fumaroles in a Valley of Ten Thousand Smokes, or searching jungle-clad Andean slopes for lost cities of the Incas, or trekking across Tibetan plateaus to visit villages unmarked on the world's recent maps, the explorer must, perforce, adapt himself to his new environment and seek to overcome such obstacles as hinder his progress. Few roses bloom in untamed lands!

Before work could proceed at Pueblo Bonito we sought out and tapped a hidden reservoir of the desert for drinking water. This well immediately became our labor barometer. As its surface rose and fell, the number of men and animals engaged in the explorations was increased or diminished. When hot July winds blew across the mesas to pile the rain clouds back upon the horizon, we measured our cistern twice a day.

When our Navajo neighbors came in with lard buckets, canvas bags, and even barrels to complain that their water holes were dry, we shared our meager supply with them and agreed that the whole country had been drying up ever since the white men arrived. When they returned later with their goatherds and horses, we clamped on the lid and told them to dig their own wells deeper.

The insufficiency of our water supply has been the chief reason why travelers have been rather discouraged from visiting Pueblo Bonito during the annual excavation season.

CORNER GROCERY IS 106 MILES AWAY

When the gods smiled and work progressed as we wished, thirty-five or more Indians, ten white men, and eight or nine horses were busy in the ruins. During four months out of the year our camp was the seventh largest settlement in San Juan County (see illustration above).

All the provisions for this evanescent village, all the hay and grain for the teams, had to be hauled from the railroad,

Photograph by O. C. Havens

EXCAVATING A KIVA AT PUEBLO BONITO

One hundred thousand tons of earth, stone, and blown sand have been carted from the ruins of Pueblo Bonito by the National Geographic Society's expeditions. When conditions are favorable, thirty-five or more Indians, ten white men, and eight or nine horses are busy in the ruins (see text, page 227).

Firewood was brought from twenty miles away. Mechanical repairs as well as future commissary requirements had to be anticipated.

Our corner grocery at Gallup was separated from our kitchen at Pueblo Bonito by 106 miles of happened-by-chance road. When this road was dry the one-way trip could be made in seven hours; during the midsummer rains our drivers always carried their bed-rolls and a week's rations.

But such local handicaps as Nature imposed were speedily forgotten as each was passed. Delays and disappointments were but temporary. Every day brought its share of work and worry; of secret thought toward maintenance of interest and contentment among our Indian workmen; of planning for the morrow and the week ahead. And every day witnessed some definite progress toward the goal set when these expeditions were inaugurated, four years ago.

Previous reports* of The Society's explorations at Pueblo Bonito have dealt more with the progress of excavations than with the nature of the discoveries. In these earlier accounts details of investigation, descriptions and interpretations of the cultural material recovered, have purposely been omitted, for it was felt that further research must certainly add to the story of which they formed but a part.

That story has not yet been wholly retrieved, but it is now possible to weave the countless threads of fact and reasonable conjecture into a single fabric of probable truth—to review the daily life of the Bonitians as they lived a thousand years or more ago.

Every potsherd, every fragment of worked stone, has its individual meaning. Our task is the faithful interpretation of this mute evidence; our hope, to breathe new life into these cold, inanimate objects.

In thus weaving the story of a prehistoric people who have left no written records, many loose ends unavoidably remain; a bit of patchwork appears now

*See the NATIONAL GEOGRAPHIC MAGAZINE for June, 1921; March, 1922, and July, 1923.

Photograph by O. C. Havens

THE EAST SECTION OF PUEBLO BONITO

This aboriginal apartment-house covered more than three acres of ground, stood four stories in height, and contained not less than 800 rooms (see text below).

and then, but the basic warp is mostly fact and strong enough to stand the supreme test of close and searching inspection.

PREHISTORIC BONITIANS LIVED LIKE MODERNS

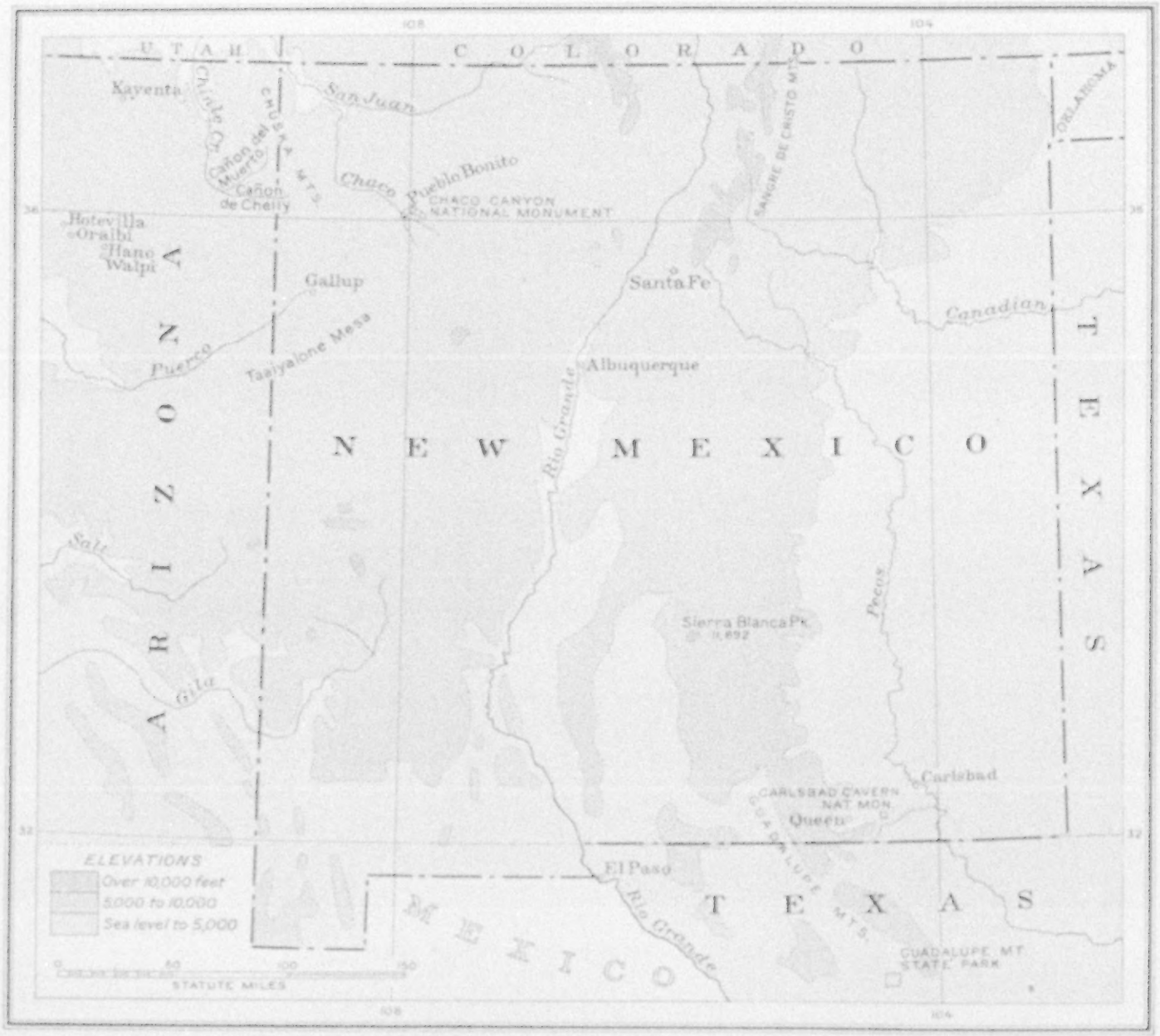
Life in prehistoric Bonito was surprisingly modern. It was both strenuous and complex; yet it remained simple, withal. It witnessed the coming together of at least two distinct groups of people and their subsequent development of perhaps the most extraordinary pre-Columbian settlement north of Mexico.

The daily struggle for existence was paramount then as now, and each inhabitant of the village, old and young alike, necessarily contributed his share to the support of the community as a whole.

That the Bonitians eventually lost in this struggle is no just argument against their diligence, their capacity as colonizers, or their skill as agriculturists. It means only that their highly organized form of community life, their particular brand of socialism, was not adapted to the environment of Chaco Canyon.

The ancient Bonitians were back-yard farmers They dwelt in a compact village—an aboriginal apartment house, if you will—covering over three acres of ground, standing four stories in height, and containing fully eight hundred rooms. No other apartment house of comparable size was known in America or in the Old World until the Spanish Flats were erected in 1882 at 59th Street and Seventh Avenue, New York City.

Desert plants furnished edible seeds and skilled hunters brought occasional game from distant mesas. Nevertheless, the principal source of the Bonitians' food-supply lay in their neighboring garden plots, where corn, beans and squash—



Drawn by James M. Darley

A SKETCH MAP OF NEW MEXICO AND EASTERN ARIZONA

In the northwest corner of New Mexico is the Chaco Canyon National Monument, within which is Pueblo Bonito, scene of five years of exploration by the National Geographic Society. Just across the State border lies the Cañon del Muerto (see Earl H. Morris' article in this number of the NATIONAL GEOGRAPHIC MAGAZINE). At the foot of the Guadalupe Range, in the southeast corner of New Mexico, is Carlsbad Cavern, scene of labor of another National Geographic Society expedition (see pages 301 to 319).

staple foods of our prehistoric, sedentary Americans—were intensively cultivated. And, if we may judge by modern Pueblo practices, the colorful clan ceremonies periodically performed by these farmers of the long ago had for their fundamental purpose the propitiation of tribal gods to the end that more bountiful harvests might be brought about.

THE WIFE WAS THE HEAD OF THE HOUSEHOLD

Historians of the Old World offer convincing argument that irrigation originated on the sandy borders of the Nile and the Euphrates. Whether this be true or not, it is well known that similar methods of crop production were developed in our own arid Southwest by Indians who had never heard of the Egyptian Pharaohs or the splendors of forgotten Babylon.

Irrigation was practiced by the people who lived at Pueblo Bonito. We know this, and yet positive proof is lacking. No definite trace has yet been found there of ditches or *acequias* for the distribution of water. Canals were hand dug by the primitive farmers of the Gila and Salt River valleys, in southern Arizona, long before Coronado led his *conquistadores*

Photograph by Charles Martin

THE HOPI VILLAGE OF WALPI, ARIZONA

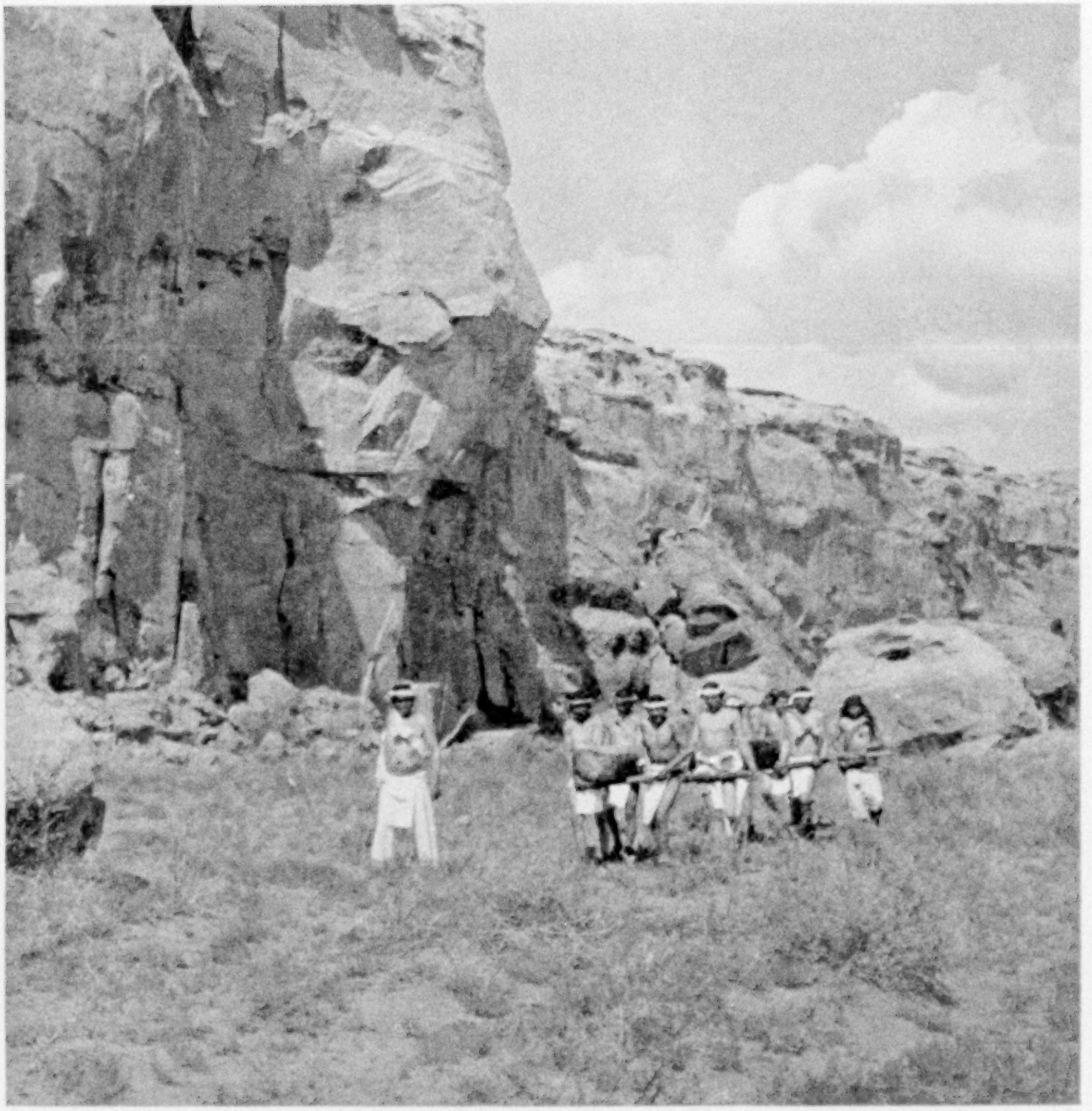
Walpi (the Place of the Notch) is one of the oldest of the still inhabited Hopi villages. It was one of the group of towns visited by the Spaniards in the middle of the 16th century, when they first came to know of this tribe. It is probable, however, that the old pueblo of Walpi was abandoned about 1680 and the present one established on the near-by mesa.

northward out of Mexico in 1540, and these very same canals are now used, in part at least, by white settlers of the region.

But in Chaco Canyon different methods obtained, since without living streams canals were scarcely feasible. Flood waters that roared down from the mesas following torrential midsummer showers were caught by low ridges of earth surrounding even the smallest inclosures, sometimes only a few yards square, wherever corn and beans would grow. By this system of inundation moisture was concentrated in the cultivated areas.

Because water is such a fugitive blessing, the present Indian population of the northern desert country has likewise learned the wisdom of using flood irrigation. The Hopi, Zuñi, and Navajo all profit to-day through the hard-won experience of their forefathers (see p. 260).

In prehistoric Bonito there existed a curious division of domestic responsibility. "Woman's Rights" were already recognized and in vogue. The head of the Bonitian household was the wife and mother, not the husband. Times have changed since then, but history tends always to repeat itself! Bonitian fathers



Photograph by Neil M. Judd

ZUÑI BOYS CARRYING A GREAT LOG AFTER THE STYLE OF THE ANCIENT PEOPLE: PUEBLO BONITO

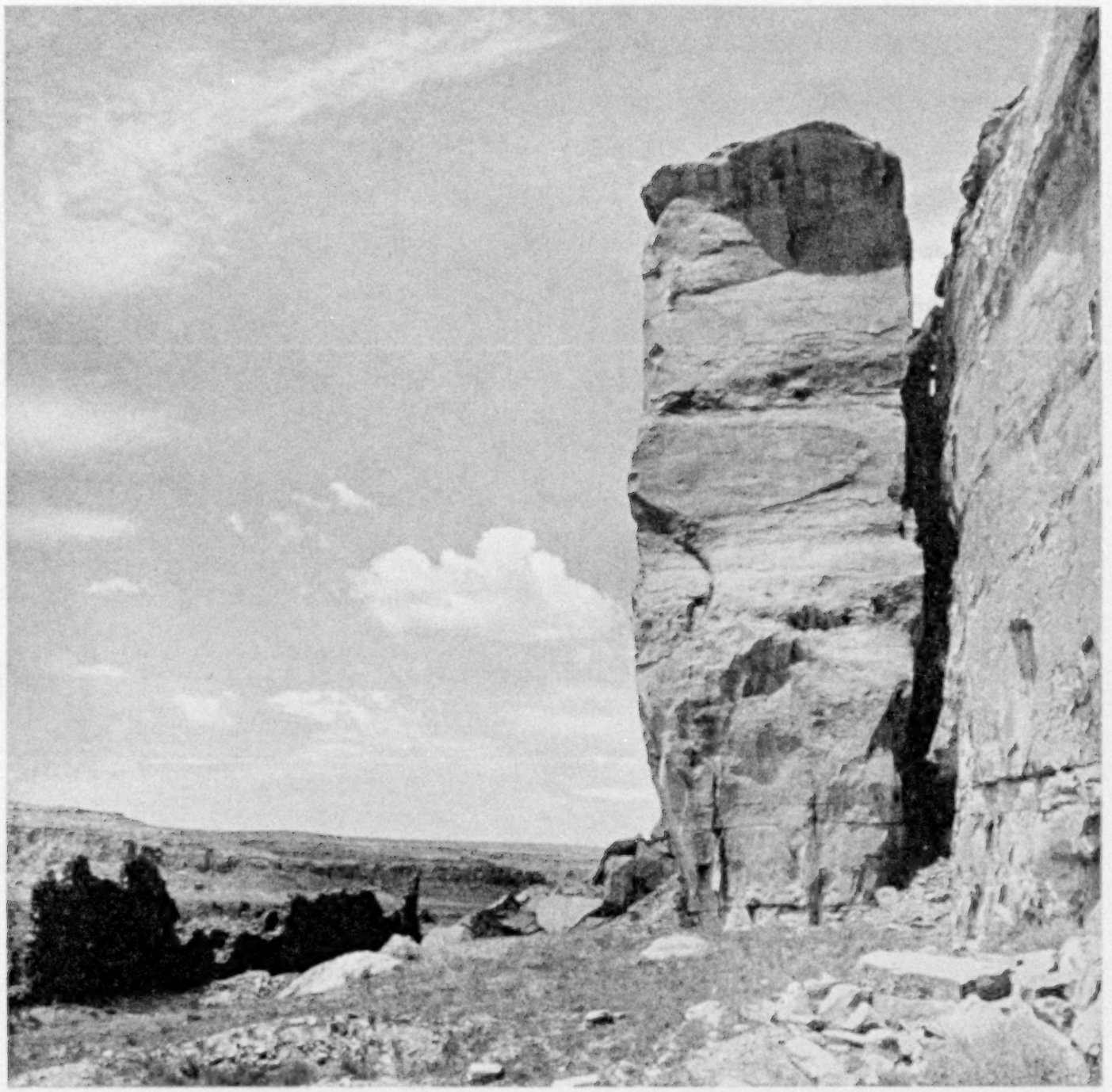
The Bonitians were great housebuilders, and, while the homes were owned and partly built by the women, the men felled and transported the huge roof timbers and placed them upon the walls. A tremendous amount of labor must have been necessary to bring these great trees from forests many miles away (see text, page 248).

had the responsibility of providing for their families, yet the women owned their homes and brooked no interference in purely domestic affairs.

Among primitive sedentary peoples this has always been true. Man reigned supreme out of doors, in the chase, for example, or in the fields. The corn was his so long as it remained unharvested, but once dried and safely stored in the dark, inner rooms of the place he called home, possession passed automatically to his better half. At her direction only it was doled out and crushed in the family mealing bins.

GRINDING STONES INHERITED FROM ANTIQUITY

Step into almost any Pueblo home of to-day and you will find *metates* (grinding stones) powdered with freshly ground meal. These characteristic stone



Photograph by O. C. Havens

THE PUEBLO BONITIANS' PUNY EFFORT TO BRACE A MIGHTY CLIFF

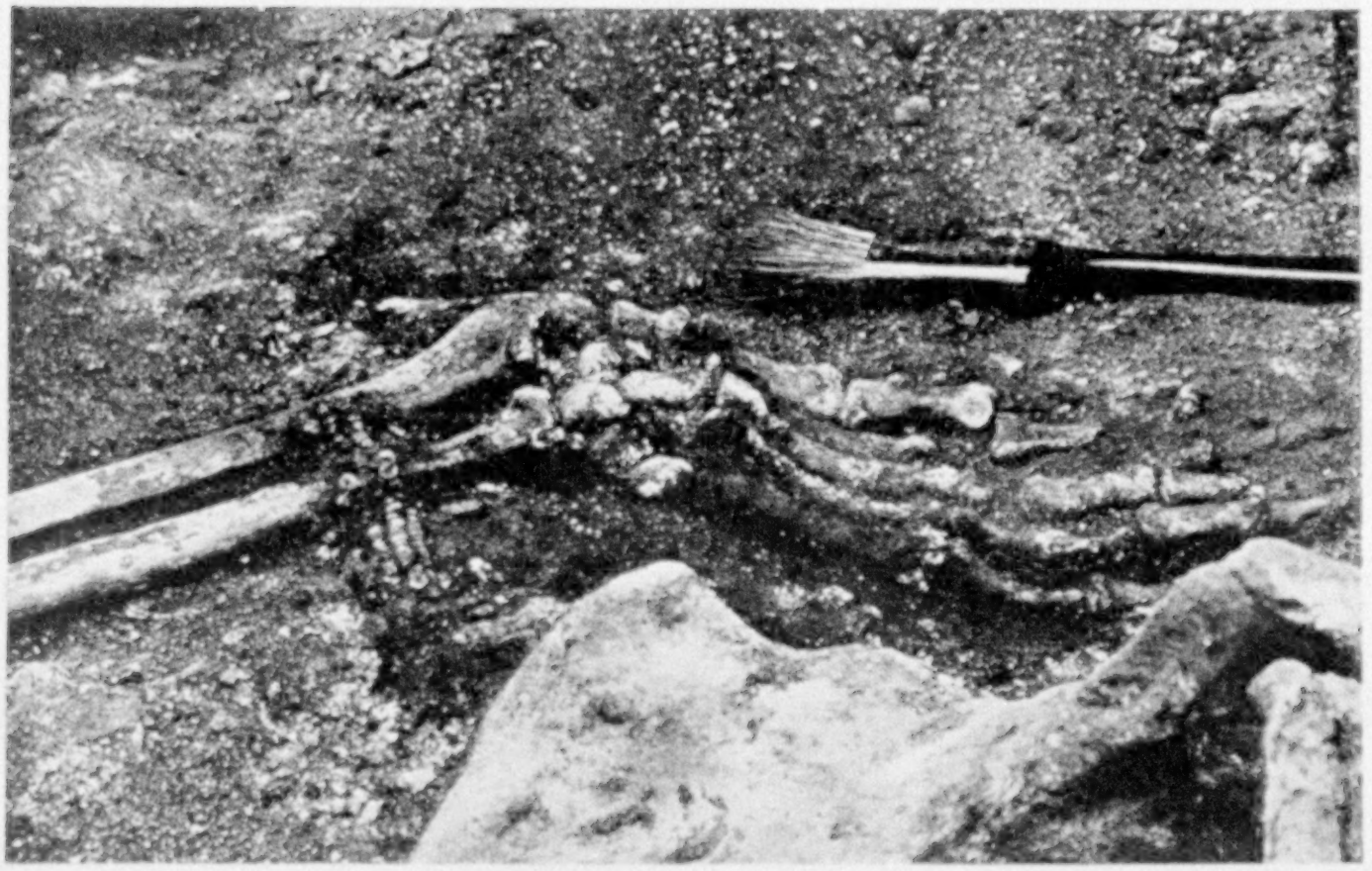
This seemingly precariously balanced mass of rock stands just above Pueblo Bonito. The Bonitians naïvely erected sticks and stones to hold back its 100,000 tons of solid rock that threatened to topple upon their village (see text, page 260).

mills have been inherited from remote antiquity. They were utilized alike by cliff-dwellers, occupying caves in the sheer-walled canyons of the Colorado drainage, and by equally ancient peoples who erected huge clay houses on the flat, cactus-covered plains of the Gila.

Indeed, with but slight variation, they were, and still are, used by the Indian populations throughout Mexico, Central America, and the countries below the Isthmus of Panama. What traveler south of the Rio Grande has not heard the rhythmic sound of the tortilla-maker echoing on the clear, cool air at daybreak?

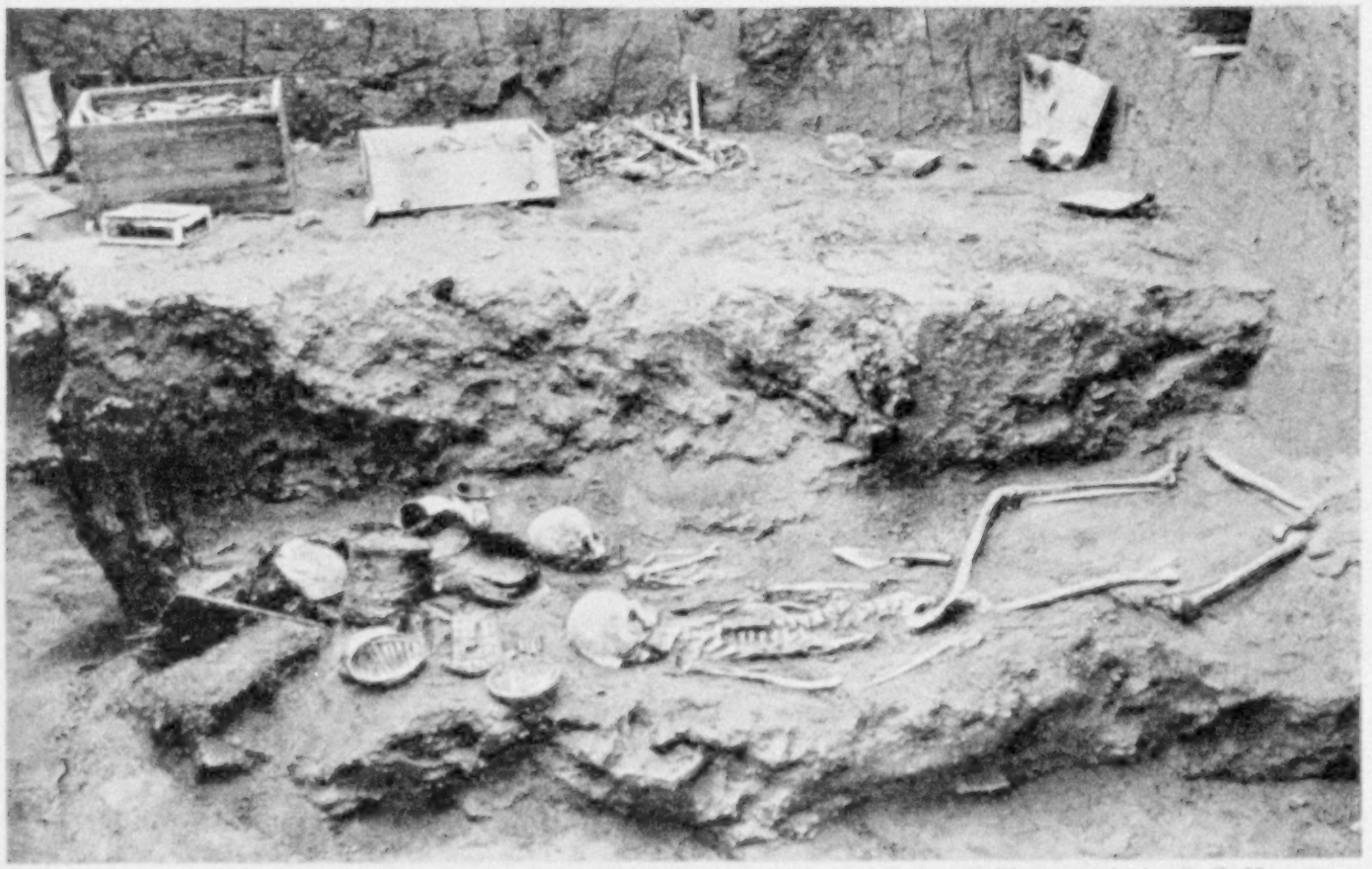
So in Pueblo Bonito a daily task for the daughters of every household was the preparation of the allotted ration of maize. Metates were brushed with a bunch of grass; the corn was shelled and crushed to a degree of fineness dictated by the particular use for which it was intended.

And while precious yellow kernels were being crunched between the milling stones, black-eyed maidens shyly gossiped of promising village swains or sang such



A BEJEWELED SKELETON AT PUEBLO BONITO

Such lure as the turquoise bracelet on this skeleton caused many of the graves of Pueblo Bonito to be opened by grave-robbers centuries ago (see text, page 245).



Photographs by O. C. Havens

THE RESTING PLACE OF AN ANCIENT BONITIAN

It is from such mortuary offerings as these that many of the most important relics of Pueblo Bonitian civilization and culture have been recovered. Note the planting sticks at the feet of the skeleton in the foreground and the four small hematite cylinders immediately above its head.

Photograph by O. C. Havens

DISTURBED BURIALS AT PUEBLO BONITO

Prehistoric peoples of the Southwest sometimes interred their dead in rooms of the village. This was done at Pueblo Bonito, but many of the bodies so buried were disturbed by grave-robbers long ago (see text, page 245). Note the elaborately decorated pottery.

pleasing grinding songs as I have often heard through open doorways at Zuñi.

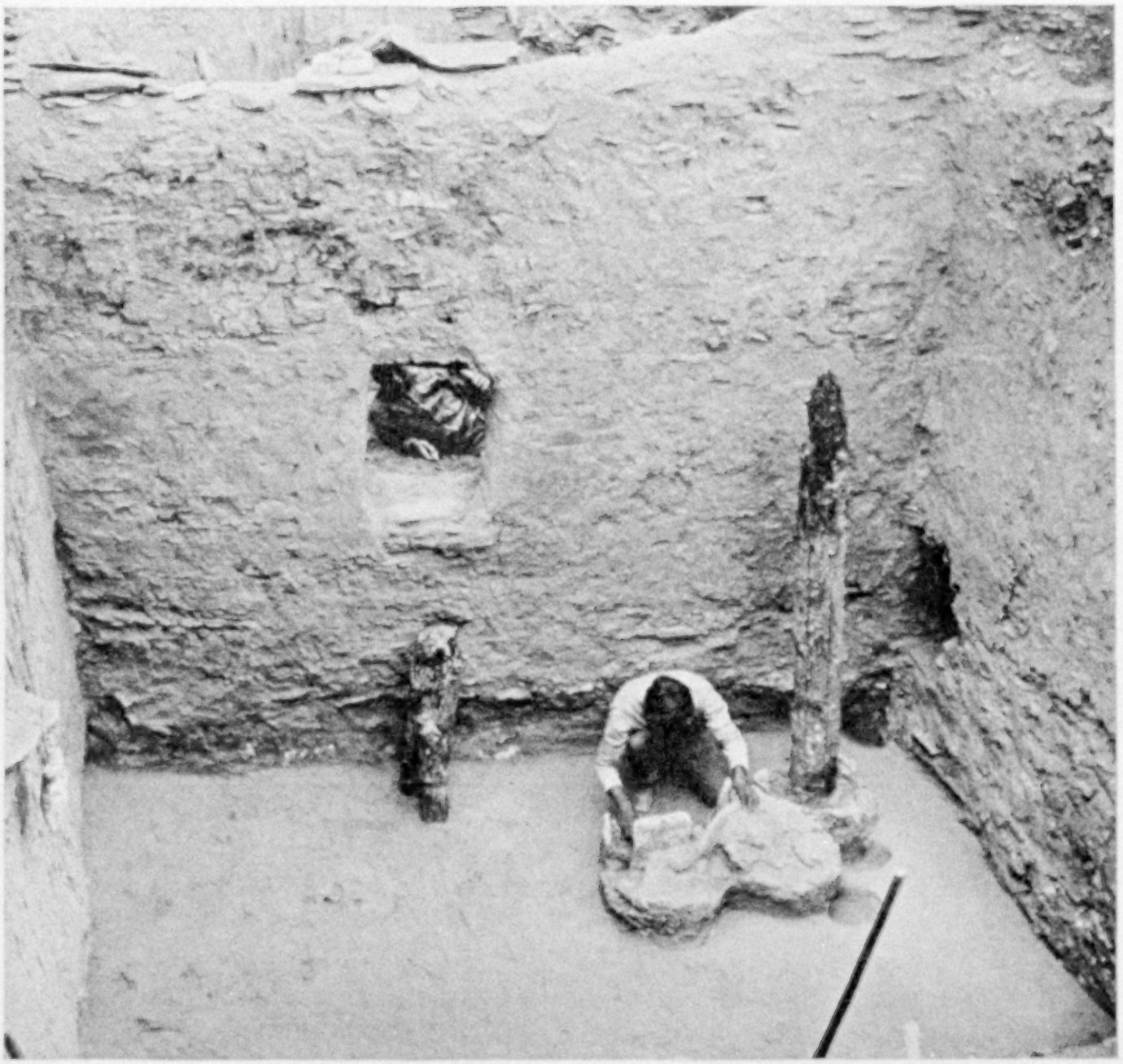
Excepting the present generation, which has been somewhat schooled in the ways of the white man, Pueblo peoples have changed but little since the very dawn of their socialistic form of self-government. Tradition connects them with the cave-dwellers and the occupants of storied communal houses in the wide desert spaces; the customs of these prehistoric town-builders are often reconstructed through knowledge of modern Pueblo life.

THE PUEBLO WOMAN'S WORK WAS NEVER DONE

Some few of us still believe in the old saw, Man works from sun to sun, but woman's work is never done. Although I am reasonably confident this time-worn adage did not originate in Pueblo Bonito, surely it was never more applicable than to the daily life of that ancient community. Indian-like, the inhabitants were up at break of day to greet the new sun as it peeped over the canyon rim and caressed with its long fingers the flat roofs of the topmost dwellings.

Shortly thereafter the menfolk turned to their fields, to pursuit of deer that had ventured too close, or to forested slopes where beams and ceiling poles were felled and barked. At the same time the women resumed the unending and varied tasks of their households.

There were skins to tan, dyestuffs and clays to fetch, pots to fashion, and blankets to weave. Such fragile stuff as cotton cloth rarely survives the passing cen-



Photograph by O. C. Havens

AN EXCAVATED ROOM IN PUEBLO BONITO

The Bonitians were expert workmen, for their mud plaster has clung to the walls for centuries. Note the figure in the passageway which leads to another room.

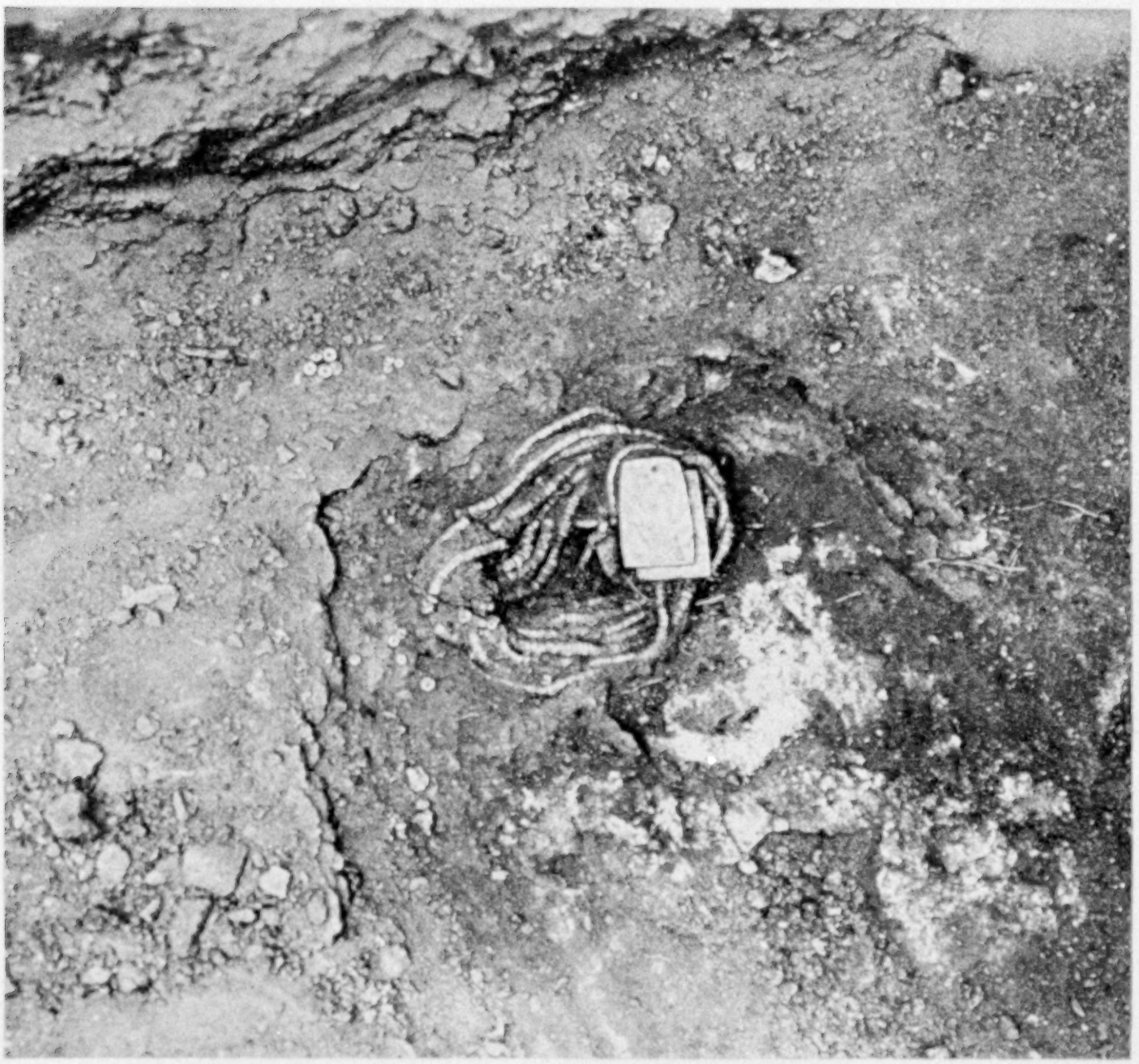
turies, but fragments have come to light from time to time—plain white fragments, fragments with colored designs and much-patched fragments.

Sandals were plaited from split leaves of the yucca or woven from its tough fibers. Baskets of many shapes and sizes were built up, coil upon coil, by skillful fingers.

BONITIAN GIRLS ROUGED THEIR CHEEKS

A Pueblo Bonito home, for all the simplicity of its furnishings, was a busy place. It was dwelling and workshop combined. And all the various materials required for each day's activities had to be gathered in the proper season for each, prepared and stored for future use.

Whether at work or play, the Bonitian women, as well as their menfolk, sought to improve upon the imperfections of Nature. They brightened their bronzed cheeks with a little touch of rouge. Not the Princess Pat, the Tangerine, the Ashes of Roses, so popular in the parks to-day, but good, old, reliable brick-red rouge, dug from the thin lenses of compact clay underneath the sandstone cliffs. Our Zuñi boys begged every fragment we came upon in the excavation and laughingly streaked their faces with it; Navajo horsemen frequently rode into camp as



Photograph by O. C. Havens

WHERE THE RICHEST FIND AT PUEBLO BONITO WAS UNEARTHED

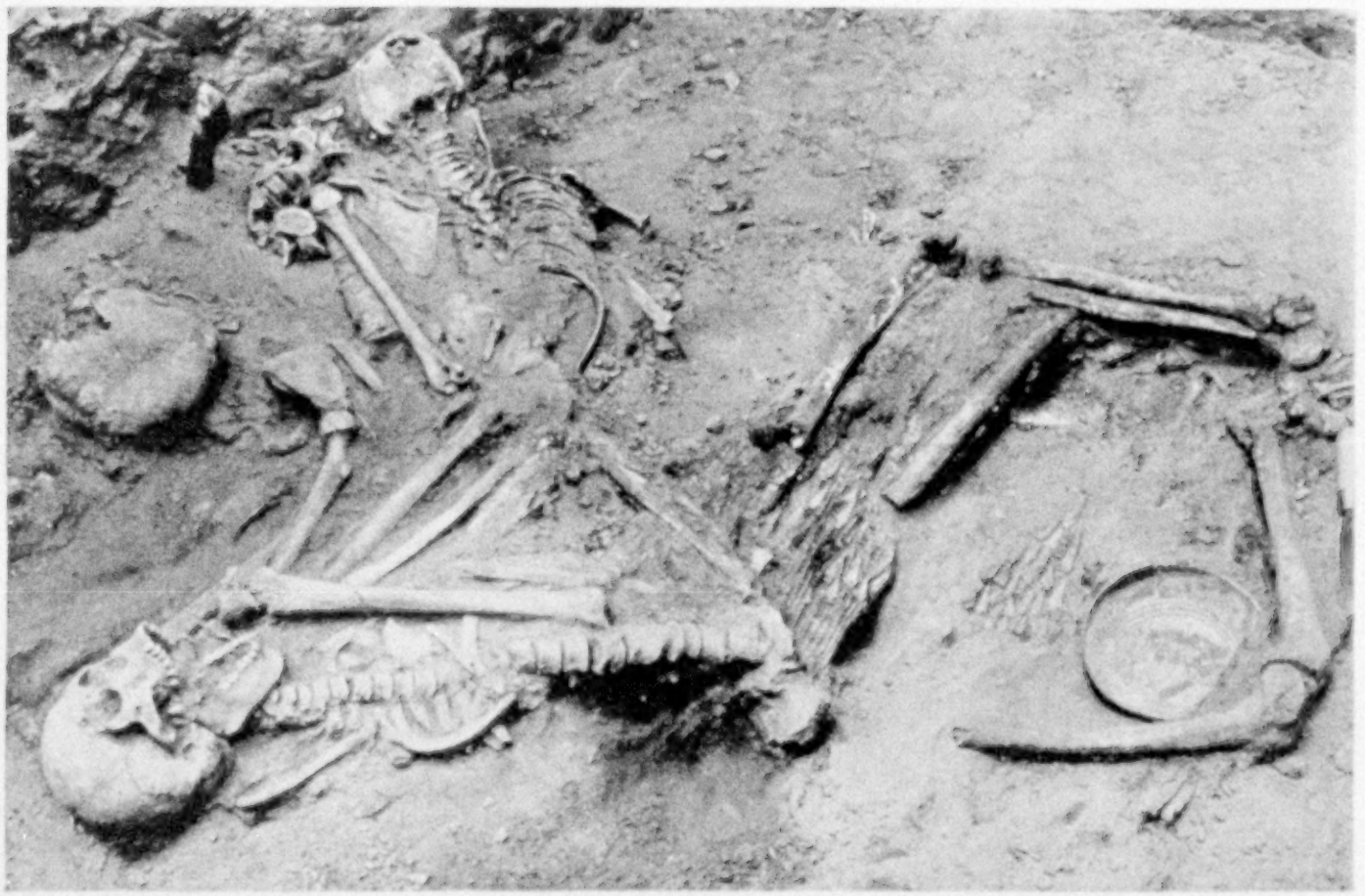
This remarkable necklace, containing 2,500 separate beads of turquoise and four pendants, represents an almost unbelievable amount of labor on the part of the ancient lapidary who fashioned it (see text, page 227, and Color Plate IV).

brilliant as an autumn sunset, their faces painted against the reflected heat of the desert sand.

PUEBLO BONITO POTTERY IS THE FINEST MADE BY PREHISTORIC PEOPLES

Members of the National Geographic Society will readily understand that, after having stood roofless under the rains of summer and the snows of winter for approximately one thousand years, Pueblo Bonito has not yielded examples of all the arts and crafts once produced within her now moldering walls. Many objects have long since disappeared; others are so fragmentary as to resist accurate interpretation. But of all these varied artifacts I know of none which has come down to us in anything like the number of pieces, as pottery.

Pottery was unconsciously elevated to the high plane of a fine art at Pueblo Bonito. Nowhere else in all the United States are earthenware vessels of ancient times found which surpass those of Chaco Canyon in beauty of form and decoration. The tracing of thin black lines over highly polished white surfaces, in patterns rarely if ever exactly duplicated, gave obvious joy to the Bonitian



Photograph by O. C. Havens

AN OPENED GRAVE: PUEBLO BONITO

Note the shafted arrows (central foreground) buried with this ancient Bonitian for his use in the "Happy Hunting Ground."

housewife. Without love for her handiwork, without justifiable pride in her skill, she never could have created such masterpieces (see page 237).

The pottery of Pueblo Bonito stands at the very apex of ceramic achievement among the prehistoric peoples of our country.

Those who have visited Pueblo Bonito and spent hours of meditation within the shadow of its broken walls find it easy to picture these women of the long ago at work with their clays and crude shaping tools. One sees them sitting in the soft light of their earth-floored dwellings, grinding and kneading and rolling into long strips clays which had been selected with great care and often transported from a distance.

The potter's wheel was not known to any of the aborigines of the New World; it is an Old World invention; but a rude substitute—a shallow basket or the bottom of a broken olla—was occasionally employed in New Mexico and Arizona as a movable worktable upon which the new vessel was fashioned.

Dwellers in the cliffs made basket receptacles before they discovered the art of pottery manufacture, but they retained in the latter industry the technique of the former. Thus it is that a Pueblo woman, even to-day, builds up a bowl or jar with long ropes of plastic earth, pinching each successive coil to firm union with its predecessor, smoothing down the rough surfaces with a bit of wood or gourd rind and later polishing the whole with a water-worn pebble (see page 248).

FINGER PRINTS PROVE SMALL CHILDREN WERE TAUGHT POTTERY MAKING

Youthful hands often helped shape new vessels to replace those broken on the hearth. Every woman had to learn the potter's trade, and her schooling began early. In fancy, I see brown-bodied little tots studiously striving to duplicate the products of their mother's hands; I hear words of encouragement uttered to soothe the impatience and failures of childhood.

In the ruins of Pueblo Bonito we have found rude, miniature ladles and pitchers bearing the imprint of baby fingers; we

Photograph by O. C. Havens

WHERE GRAVE-ROBBERS HAVE LEFT THEIR MARK

have unearthed toy bowls, shaped and painted by skillful hands to serve as object-lessons for restless beginners. And how simple the task must have seemed, in these models lovingly prepared!

YOUTHFUL PUEBLO BONITIANS HAD MANY PETS

Childhood in Pueblo Bonito did not differ greatly from that of our own time. It had its tragedies and its joys. Only the environment varied.

In their everyday life, the prehistoric toddlers of Chaco Canyon were not especially humored by their parents. Their childish desires were simple and easily satisfied. A cottonwood stick wrapped with a skirt of cedar bark or a cotton rag served as a doll. A knotted yucca leaf, a potsherd, or a feather on the end of a string became toys for a time.

Pets, too, there were. Coyote pups to romp with and maul about; tethered ground squirrels, perhaps, and rabbits galore. Eagles and red-tailed hawks moped in wickered cages; imprisoned turkeys begged crumbs and sunflower seeds. Brilliant macaws from the tropical forests of Mexico—treasured clan totems, safely guarded by ritualists of the kiva—could not but excite the wonder and admiration of youthful eyes.

And then there were always bright-colored stones to be counted and recounted and hidden again; butterflies to chase in summer and daubs of mud to throw when other amusements wearied.

But daytime was not all playtime for the children of Pueblo Bonito! Little girls must needs tend still smaller brothers and sisters or assist in the ceaseless duties of the home; little boys had their share of work in the fields, planting seeds in early springtime and, later, nursing each individual plant through the hot months, until seasonable rains brought new life to parched gardens.

Turning over hard, dry soil with sharp sticks was no easy task, even for full-grown muscles; pulling prickly weeds made hands sore; guarding fields from destructive pests was a never-ending chore. Worms had to be hunted out and killed, lest the harvest be reduced through their insatiable appetites.

At times grasshoppers came in countless hordes to eat the tender green leaves through which growing plants feed. And

AN ART SCHOOL

The arts and crafts known to the Zuñi have been very effectively handed down from one generation to another in such schools as this.

Photographs by Charles Martin

INDIAN MILLERS

The *metates* or grinding stones used by the Zuñi in making meal are very like those used in Pueblo Bonito. These stone mills are an inheritance from remote antiquity and have been utilized by primitive peoples in many parts of the world (see text, page 234).

Photograph by O. C. Havens

A HOPI KACHINA MAKER

The Hopi religion takes into account innumerable subordinate supernatural beings known as "kachinas," a term which refers to the inherent magical powers for good or bad attributed to every natural object. Many of these kachinas are personalities of clan ancestors, while others are beings of unknown significance, but possessed of magic powers. Each kachina is endowed with individual characteristics and is represented in at least six different symbolic colors.

those thieving rascals, the crows, required constant watching. They would scratch out newly sown seeds, pull up the young sprouts, strip ripening ears of their milky kernels, or rob the mature stalks of their grains. Nothing so delights a crow as an unprotected cornfield!

HUMAN WOLVES PREYED UPON PEACEFUL PEOPLE

But there were other and more dreadful enemies to guard against. Human wolves crept in through autumn shadows to prey upon the village and steal all that could be carried away. From far across the mesas these pillagers came. We do not know who they were, nor how far they traveled, but we do know they came.

Nomads they were; hunters by instinct and rovers by preference. To them, such sedentary, home-loving folk as the Bonitians were fair game; to them, corn ripening in the fields or drying on the housetops was a prize well worth striving for.

Lone workers in the gardens were slain seeking shelter; boys and young women were taken captive and dragged away as slaves of the invaders.

No witness of these periodic attacks remains; no record of them was ever written. But similar strife between sedentary and nomadic peoples has been waged since man became man; it forms a considerable portion of the world's history. The depredations of Geronimo and his outlaw band are yet a vivid memory along the Mexican border. Old men still resident in Zuñi and in the Hopi pueblos, as boys, have lived through raids by mounted Navajo; have seen their playmates slaughtered, their sisters stolen, the goats and sheep they tended decimated or driven away, and piles of ripened corn loaded on mules for transport to distant camps.

Such brigandage continued unchecked during the Spanish and Mexican occupancy of the Southwest; it was brought to an end only through American efforts during the second half of the 19th century.

MAKING A PEACH BASKET

For the harvest the Zuñi women weave deep, sturdy burden-baskets which have a capacity of about a bushel. They are made largely of skunk-bush shoots.

Photographs by O. C. Havens

NAMPEYO, MOST FAMOUS OF MODERN PUEBLO POTTERS

The Pueblo people of the Southwest are to-day, as in the past, masters of the ceramic art. This Tewa squaw of Hano Pueblo, Arizona, is holding one of her masterpieces.

The earliest known description of Pueblo Bonito and its neighboring ruins was written by Lieut. J. H. Simpson, attached to Colonel Washington's command on a punitive expedition against the Navajo in 1849; and the southern Apaches were not completely subjugated until a much later period.

It would indeed be interesting could we learn what enemy tribes worried the prehistoric Bonitians. That their attacks were relentless and recurrent has been established by The Society's expeditions. The single gateway to Pueblo Bonito was reduced to a narrow door, and this was subsequently and permanently closed in the interest of still greater security. Thereafter, access to the great house was gained by a ladder which, in time of necessity, could be drawn up to the rooftops.

INHABITANTS FORCED TO SEAL THEIR DOORS AND WINDOWS

Doorways and elevated windows in the curved outer wall of the pueblo were all closed with masonry long before the village was finally abandoned. Without deep-rooted fear of savage marauders, these precautions would never have been taken. With the passing years the Bonitians drew more and more within the shell of their pueblo, as a tortoise, when threatened, retires within its carapace.

But even closed doors and a blocked gateway did not entirely shield these ancient folk from their enemies. The latter, gaining confidence from repeated successes, returned to the attack with ever-increasing frequency.

Peaceful villagers are no match for trained warriors. Hand-to-hand struggles were waged in the very courts of the village; hafted stone axes and wooden war clubs bruised brown bodies and broke many a bone; flint-tipped arrows sought out crouching defenders of the terraced houses. Terrifying war cries echoed through the canyon; fearful women hurried weeping children to the shelter of inner rooms.

Again, we may only surmise the general fact of such sporadic warfare, since no definite proof of it has come down to us. The Bonitians kept no diary of passing events and the glyphic carvings they pecked on the cliffs remain mostly unintelligible. But similar defense against hostile tribes within the past century was forced upon the various Hopi towns of Arizona, upon the Zuñi of western New Mexico, and the Tewa of the Rio Grande.

Final abandonment, in 1838, of Pecos—the largest Pueblo village visited by Coronado on his expedition in 1540—was a direct result of relentless attacks by Comanche war parties from the Texas plains. And like conditions almost certainly obtained during the occupancy of Pueblo Bonito, if we may judge from the circumstantial evidence at hand.

SEVENTY-ONE BODIES FOUND, VICTIMS OF GRAVE ROBBERS

Not only did these unknown marauders execute systematic and periodic raids against the Bonitians, killing the men when possible, stealing their women and children, and plundering their fields, but they even pillaged the burial chambers.

Prehistoric peoples of the Southwest sometimes interred their dead in rooms of the village. Four such rooms have been found in Pueblo Bonito.

Of the seventy-one bodies buried there, most had been wantonly disturbed at a time shortly before, or shortly after, the village was deserted by its builders. If the former, we may be sure the defenders had been so reduced in numbers as to be well-nigh helpless against their enemies. Herein lies one possible reason for the abandonment of Pueblo Bonito.

In these four chambers a most astonishing condition was found to prevail. Skulls had been tossed aside; arms and legs had been torn from desiccated bodies that lay crushed on their burial mats; toe and finger bones, ribs and vertebræ, were scattered in hopeless confusion; mortuary offerings—baskets, earthenware vessels, and implements formerly used by the deceased—had been overturned and trampled upon (see pages 236, 237, 240, 241, 255).

And the cause of all this destruction? Hasty, vandalistic search for turquoise or other treasured ornaments buried with the dead (see page 239).

WEALTH RECKONED IN TURQUOISES

Nothing was more highly prized than the turquoise by the Pueblos of a thousand

Photograph by O. C. Havens

A ZUÑI SMILE

Like most of the other Pueblo tribes, the Zuñi are quiet, good-tempered, industrious, and friendly.

years ago, as by their descendants of to-day and the latter's near neighbors, the Navajo. Turquoise, symbolic of the blue desert sky! Turquoise, whose soft colors embody the spirit of the vaulted heavens and the restless expanse of mystic oceans!

Indians of the mesa country are rated not by the number of their horses, their sheep, or their goats, but by the amount and perfection of their turquoise possessions. Turquoise to the southwestern Indian is as the diamond to city-dwellers. A pendant worth $10 by weight will, if its color has been tested through long use, buy 100 goats or 30 ponies. Perfect stones from prehistoric ruins are priceless.

When the Expedition's incomparable necklace first came to light, every Indian on the force dropped his shovel and hurried to peer over the wall. The Zuñi boys lost interest in the excavations; the Navajo lost their fear of the evil spirits that hover about burial places. All draped themselves over the insecure walls to watch what was going on in the deep room below.

Our original Americans possess some mysterious means of radio communication—a highly developed mental telepathy—or a method of transmitting thought that still defies detection. Let some important event take place and every Indian for miles about seemingly will know of it before you have a chance to send word to him.

And so it was with the necklace. Five minutes after my hand trowel had cut away the covering of earth to reveal this most unexpected and magnificent discovery, every one of our workmen was there as an inspector of operations.

It was impossible to gage their inner feelings. They talked in whispers. Silently they watched our tiny brushes sweep away the particles of earth and sand. And when at last the blue stones shone forth in all their ancient splendor, such subdued exclamations as rose from our audience; such obvious admiration; such reverence, almost, with which they looked upon this treasure of a thousand years ago! (See Color Plate IV.) And a happy boy it was who received the task of removing the specimen.

Turquoise deposits in New Mexico and Arizona have been worked since ancient times and at least one of them furnished the Bonitians with their matrix. Possession of such deposits gave great prestige to a community, for the mineral frequently served as a medium of exchange. The famous Tiffany mines at Los Cerrillos, south of Santa Fe, are still claimed by the Indians of Santo Domingo.

Fray Marcos de Niza, setting forth from Culiacán in 1539 to search out the fabled "Seven Cities of Cibola," met Mexican Indians returning from the north with *chalchihuitl* purchased with feathers from tropical birds. Even in olden times the treasures of one region were more highly valued by the residents of another.

Photograph by O. C. Havens

A TURQUOISE DRILLER

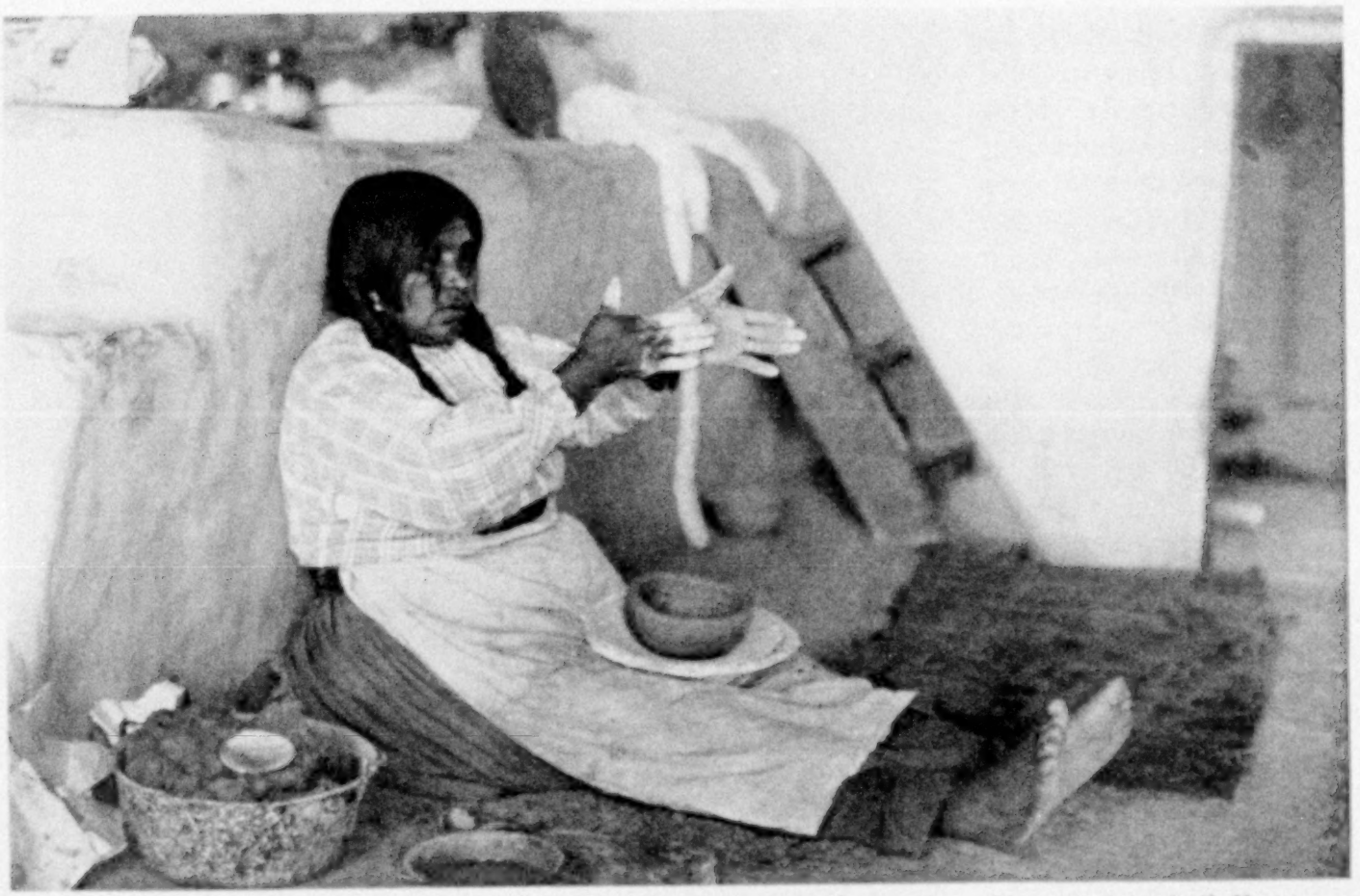
For ages turquoise has been the highly prized treasure of the Indians of the Southwest.

WOMEN BUILT AND OWNED THE BONITIAN HOMES

The wealth of Pueblo Bonito was widely famed in prehistoric days. It brought venders of parrots from Tamaulipas and Vera Cruz; it prompted native dealers in sea shells to the difficult and dangerous foot-journey eastward from the Pacific; it tempted nomadic desert folk to recurrent and devastating attacks. Although a thousand years have passed since Pueblo Bonito was in its heyday, it is still venerated, at least in Navajo tales, because of the jewels worn by its builders.

But the Bonitians themselves were not lost in idle ostentation. They have left too convincing a record of their industry, their tireless energy, their lack of content with existing things. On festive occasions, when dancers marched from the kiva publicly to invoke aid of the rain gods or to give thanks for successful harvests, the finest raiment of the villagers was displayed; at other times bare backs bent to numerous and arduous tasks.

Among all the diversified activities of Pueblo Bonito, few were more persistently practiced than that of house-building. Like the proverbial beaver, the Bonitian was always busy; but, unlike the beaver, he seems rarely to have been satisfied with his own creations. Just why this should be, it is impossible to say. It may well have resulted from the inevitable



Photograph by O. C. Havens

ROLLING CLAY COILS FOR POTTERY

After the base of a pottery vessel has been formed, a small ball of clay is rolled between the palms into a thin rope, and this is then coiled round and round the edge of the gradually growing bowl or jar. At frequent intervals the potter smoothes the receptacle inside and out with a bit of gourd shell (see text, page 239). The potter's wheel was not known to the aborigines of America.

conflict between secular and ceremonial ambitions.

With increasing population, there came a need for more and more dwellings; also for larger or additional kivas, the circular, subterranean rooms inhabited by unmarried men and utilized by the several fraternities or religious societies.

The dwellings, be it remembered, were the recognized property of the women. When a man married he went to live with, or near, his wife's people. This is an old, established custom among the modern Pueblos—a custom which has survived the fleeting centuries and the abrading influences of a dominant civilization.

CEREMONIAL KIVAS BUILT BY THE MEN

The women not only owned, but they also built, their homes—another Pueblo custom which has persisted to within the present generation. Of course, the men participated in this work. They quarried and transported the stone; then fetched the huge roof timbers and seated them upon the walls. But the houses, nevertheless, were the exclusive property of the women.

In direct contrast, the kivas were owned and occupied by the men-folk. It seems entirely plausible that the members of the several masculine societies joined hands in building their respective lodge rooms. If we could be absolutely certain of this point, it might explain the fact that kiva masonry is invariably inferior to that of the dwellings proper. We must assume, perforce, that the women of Pueblo Bonito were better masons than their husbands.

Because the welfare of the entire community depended upon the faithful performance of prescribed rituals, the influence of the ceremonial chamber was stronger than that of the home. We have noticed repeatedly, during exploration of Pueblo Bonito, where two or four adjoining rooms were sacrificed to provide space for a single kiva. In such instances the partition walls only were razed, leaving

Photograph by O. C. Havens

YOUNG MOTHERS OF A ZUÑI PUEBLO, NEW MEXICO

All of the Pueblo people are monogamists, and the status of women is much higher than among most Indian tribes, although marriage is effected with little ceremony and divorce is lightly regarded.

those opposite to form an inclosing square for the circular structure.

The purpose of this arrangement is easily understood. Ceremonial requirements placed the kiva at an elevation lower than the living rooms, for the kiva symbolized an earlier world, which man reached on his rise from a more primitive state and from which, in turn, he emerged into this world of the present.

To provide new kivas at Pueblo Bonito without encroaching upon the two courts or plazas where public ceremonials were presented, the men turned toward the residential area immediately surrounding the plazas. We may suspect vigorous, though temporary, feminine opposition to this infringement. But established religious rites formed the very hub about which the daily life and hopes of the whole village revolved.

NO WEALTHY GROUP IN ANCIENT DEMOCRATIC COMMUNITY

It was but natural, therefore, that religious necessity should prevail, and that mere dwellings should give way to ceremonial chambers. Inclosing walls were left standing about these kivas merely to simulate the required subterranean position of the latter.

In spite of the large number of their

Photograph by O. C. Havens

BAKING CORN CAKES

These thin disks of bread, known as *piki*, form a staple of diet of the Southwestern tribes. They are being cooked on a hot stone slab, just as the Bonitian housewives must have cooked them a thousand years ago.

Photograph by O. C. Havens

A GIRL WEAVER

Like their neighbors the Hopi and the Navajo, the Zuñi are skilled weavers of blankets and belts. Their textile work is durable and shows great variety of design. The Navajo blanket has become one of the most popular articles of Indian handicraft.

Photograph by O. C. Havens

PREPARING BASKETRY FOR REMOVAL FROM THE RUINS OF PUEBLO BONITO

These relics, which have lain buried for a thousand years or more, must be carefully handled if they are to be taken intact from their resting place and deposited in the National Museum, Washington, as a loan collection from the National Geographic Society.

ceremonial rooms and the probable influence of their priestly groups, the Bonitians were a democratic people. They granted no special privileges. Among all the rooms of Pueblo Bonito, no single dwelling can be pointed out as the home of the most influential. Each inhabitant had work similar to his fellows.

Head men were no doubt selected periodically and for definite terms of office, as with the Pueblos of to-day. We find no evidence to the contrary. Representative government prevailed; clan leaders and designated members of the secret societies made up the town council, and this body, in turn, chose what we might properly term the mayor, decided factional disputes, and apportioned the arable lands.

Living quarters, except for insignificant variations in size, were singularly alike. Masonry walls, usually plastered with adobe mud, rose from clay floor to beamed ceiling. Wall pegs supported casual garments, while shallow niches held such lesser objects as flint knives, personal possessions, and the bone awls and sinew used constantly in sewing.

Tanned skins and blankets of rabbit fur, neatly piled to one side during the day, were spread out on the bare floor as beds at night. A tuft of eagle feathers, suspended from the ceiling, protected the household from evil spirits, as it swayed gently with the soft movement of air through the rooms.

Generally speaking, ventilation is no great concern of aboriginal peoples; and yet, unlike other prehistoric house-builders of the Southwest, the Bonitians provided for it by leaving squared openings in the upper walls of their dwellings. Thus was fresh air conveyed to the dark, inner rooms, where corn and other foodstuffs were stored between harvests.

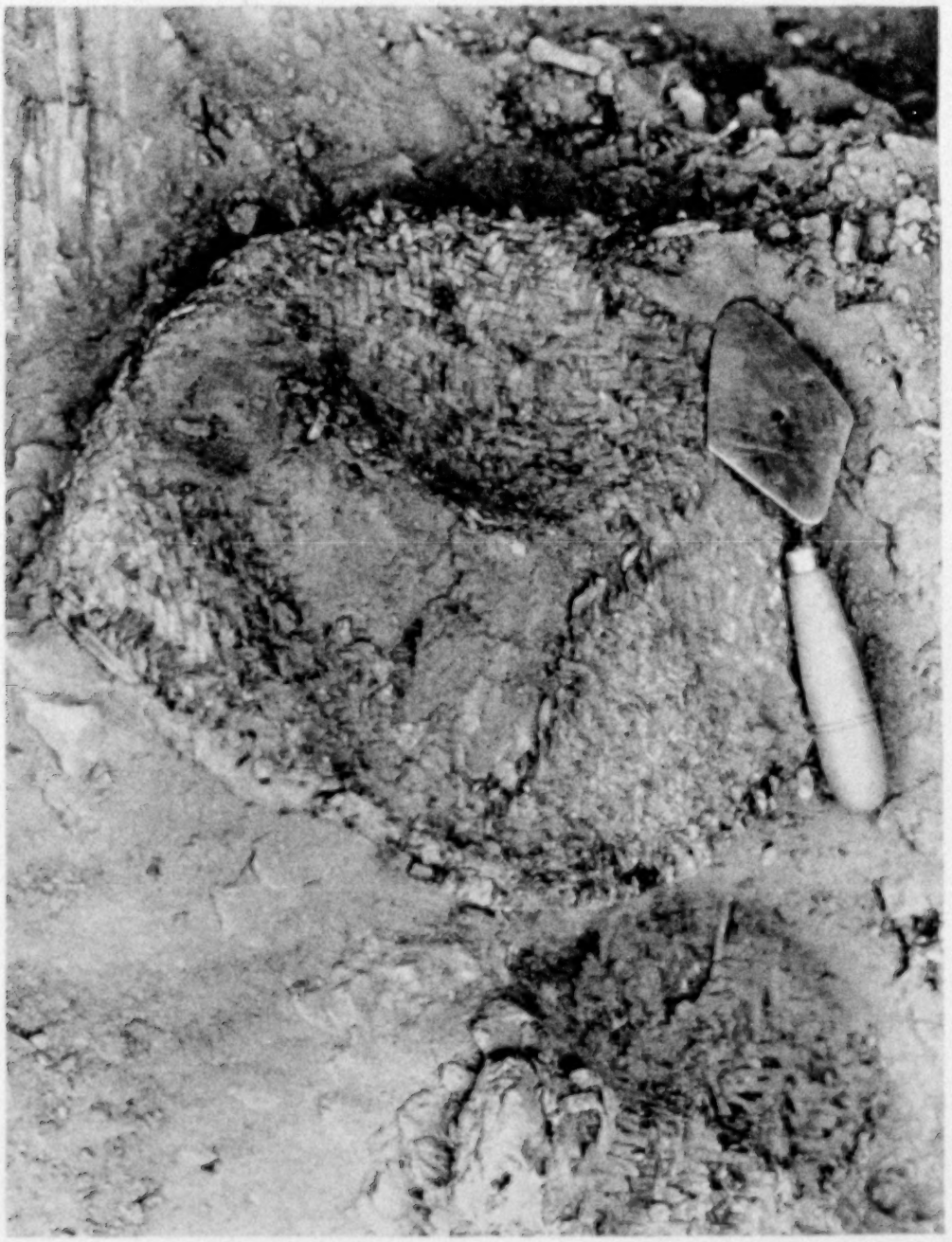
But crotchety old men apparently complained of the drafts caused by these ventilators, for we have found many of them partially or wholly closed, and in the outer wall of the last addition to the village no openings of any sort occur.

Now, it is a curious fact that very few rooms in Pueblo Bonito contain fireplaces. They are present in the older portion of the village; more rarely in the newer.

THE KITCHENS WERE ON THE ROOF

Cooking was done in the open courts; also on the flat roofs of the houses, for most of the inhabitants dwelt in second, third, or fourth story suites. The tempting aroma of a rabbit stew boiling in an earthen pot, of green corn or antelope ribs roasting on hot coals, drew hungry lads from their play and proud fathers from the serious business of community affairs.

A common fallacy, too widely current among the reading public, is that our American aborigines are dirty and unkempt. While this is true of some of the more nomadic tribes, it will not hold for all. The average Indian, living in his natural environment, may have standards that differ somewhat from our own, but he is as clean as need be, both as to his person and his surroundings.



Photograph by O. C. Havens

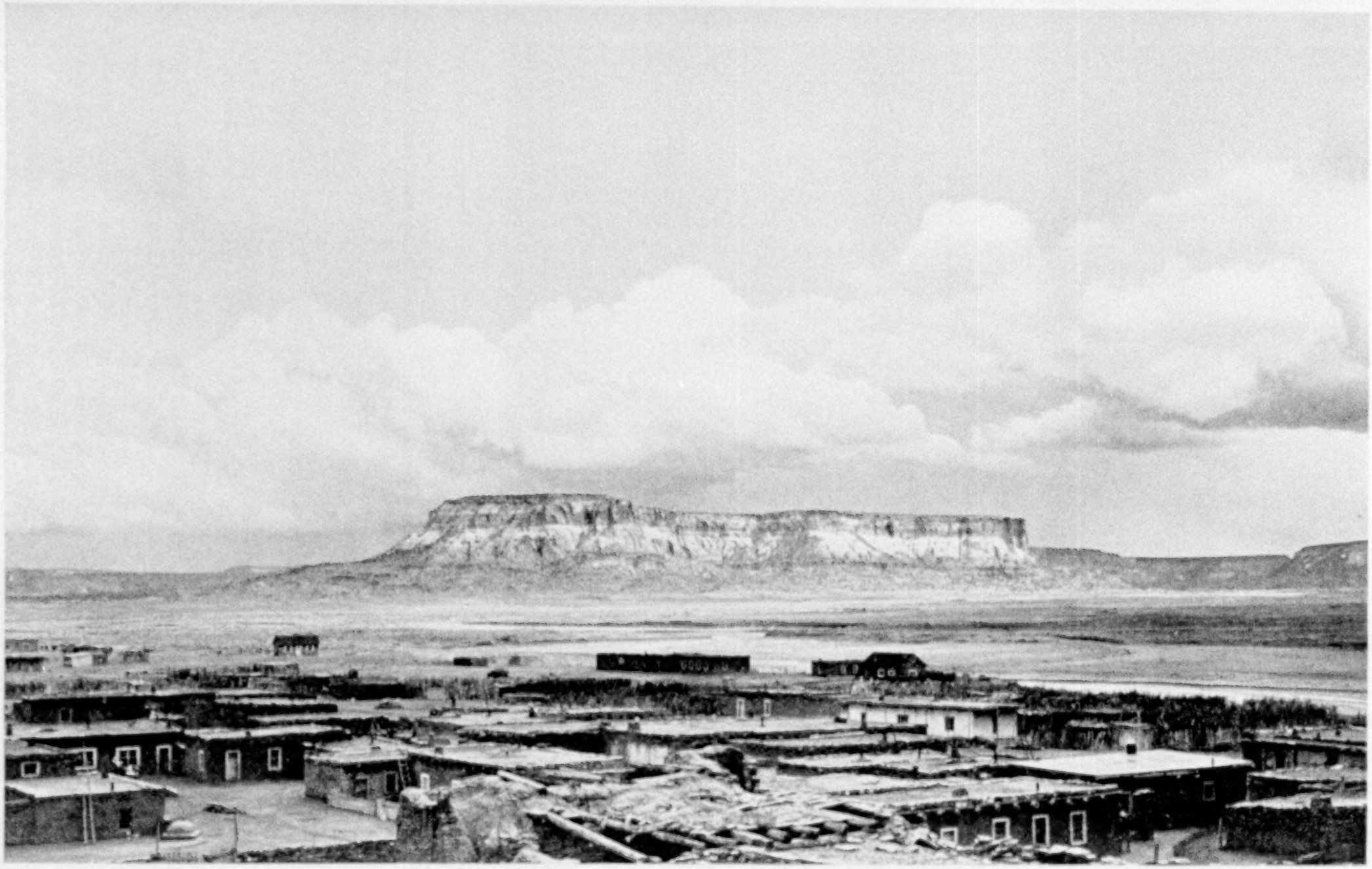
HOW ANCIENT BASKETS WERE FOUND AT PUEBLO BONITO

Only the extremely dry climate of the Southwest has made possible the preservation of these fragile relics of a long-vanished people. Their preservation after excavation is an intricate and delicate undertaking.

The Hopi, Pima, and Papago, for example, not only sweep their houses, but their dooryards as well. I have no hesitancy about sitting down on the earthen floor of a Zuñi home to share with my hosts a meal in which knives and forks play no part.

Bonitian wives were equally good housekeepers. With a hand broom of dry grass they regularly brushed their living quarters; then sprinkled the floors anew with water that the clay might become smooth and hard-packed. Their husbands, on the other hand, were a bit careless. We often find in the kivas, where women were not permitted, that an entirely new floor was spread to conceal an accumulation of dust and ashes. Sometimes several of these pavements appear, one close upon the other.

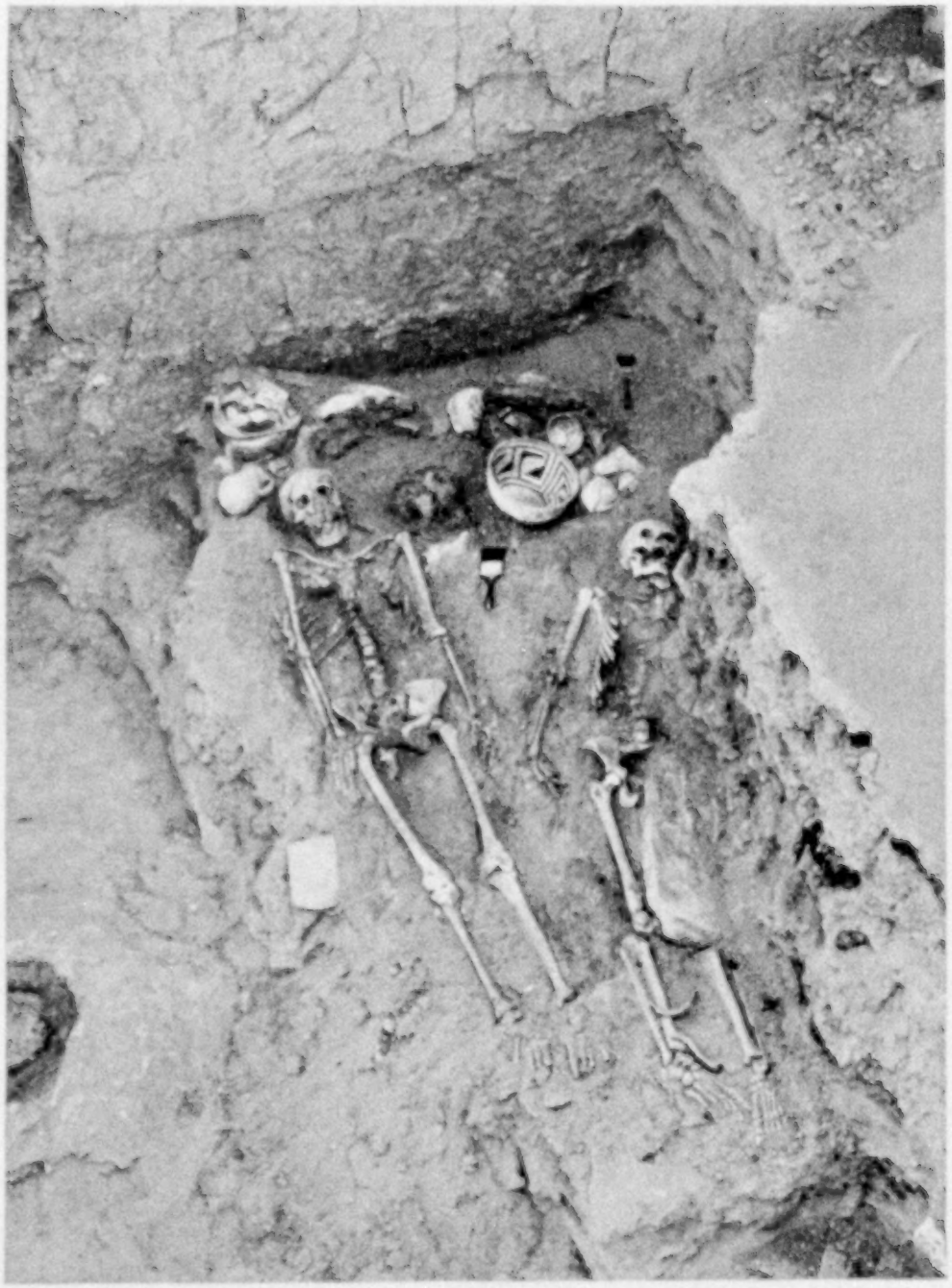
It, perhaps, ill becomes an anthropologist seriously to criticize the domestic habits of those he studies; but I find one outstanding fault with the housekeepers of prehistoric Pueblo Bonito: They were



Photograph by O. C. Havens

TAAIYALONE MESA, WITH A ZUÑI PUEBLO IN THE FOREGROUND

The famed "Seven Cities of Cibola" have been definitely identified with the seven pueblos of the Zuñi. When Coronado reached them, in 1540, he found, much to his chagrin, only a group of ordinary Indian pueblos with none of the reputed wealth. The principal of these pueblos, Hawikuh, he stormed, the Zuñi fleeing to Taaiyalone Mesa, their retreat and stronghold in time of danger.



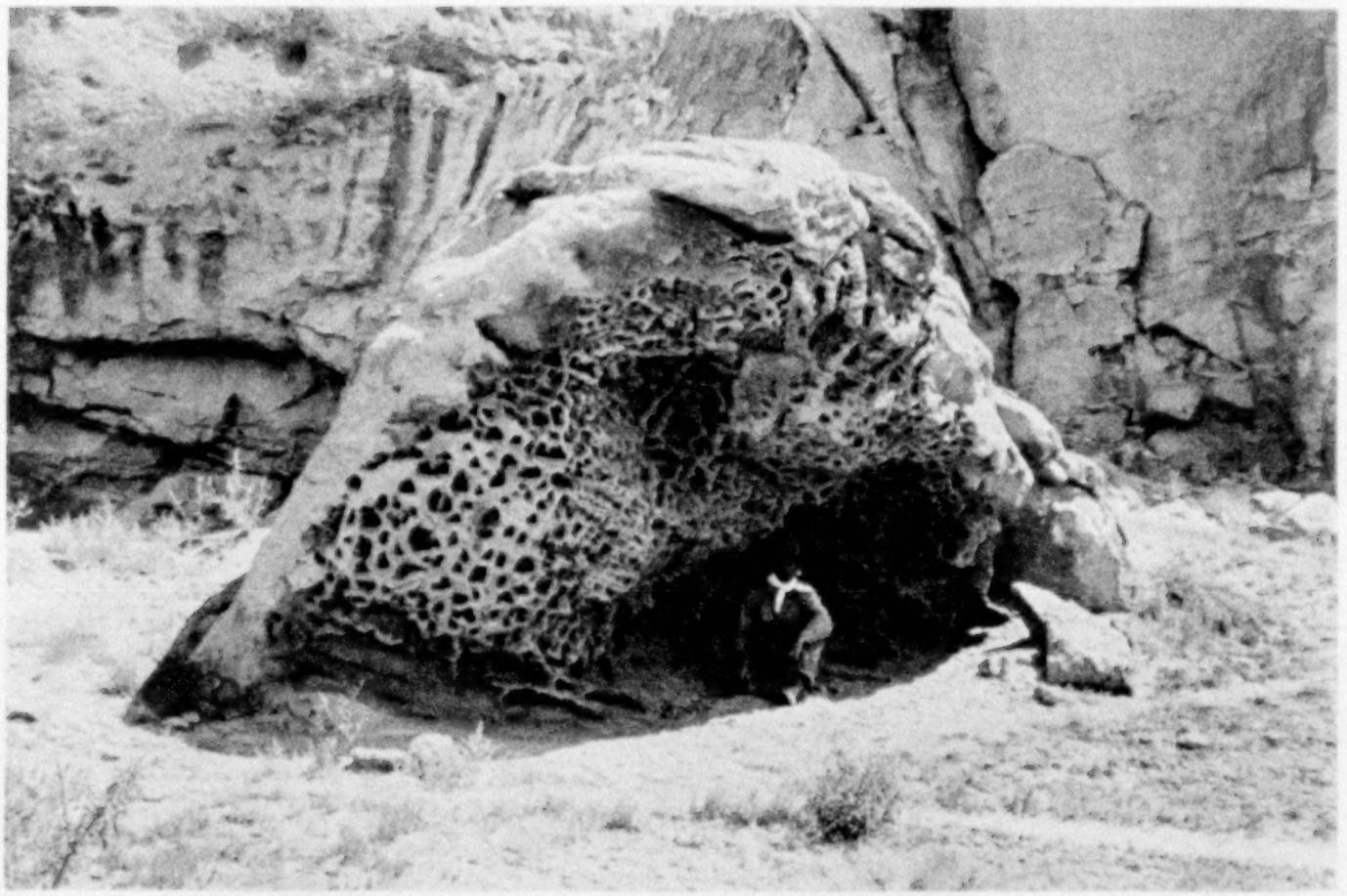
Photographs by O. C. Havens

BURIALS AND MORTUARY OFFERINGS IN PUEBLO BONITO

From time immemorial it has been the custom of the American Indian to bury with his dead certain articles for use in the spirit land. These included bowls, baskets of food, smoking material, jewelry, and ornaments, weapons, and agricultural implements.

BUFFALO DANCERS

Animals and animal spirits play a large part in the ceremonial life of the American Indian. To buffalo, bear, wolf, antelope, and various birds and serpents supernatural powers are ascribed and in their honor dances and other ceremonies are performed.



Photograph by O. C. Havens

THE WORK OF WIND AND SAND IN CHACO CANYON, NEW MEXICO

Upon this massive bowlder the elements have chiseled an inscription telling of their power.

too thorough. A beautiful jar, hopelessly shattered through an unfortunate accident, was discarded without any consideration for future archeologists.

The larger fragments were gathered up and thrown on the village rubbish pile or into some convenient, abandoned dwelling; the lesser pieces were removed with the daily sweepings. And I have sometimes thought while searching for lost parts of a particularly charming vessel, that all the pieces had been carefully divided at the time of the accident into half a dozen or more fairly equal piles, and that these in turn were then handed to the several youthful members of the household and sent to the four cardinal points, there to be cast on wholly separate and distinct trash heaps. If Bonitian wives had deliberately set about rousing the archeological ire, they could have found no more certain means than this.

THE ANCIENTS WERE CONSTANTLY REBUILDING

One of the most astonishing discoveries yet made in the ruins of Pueblo Bonito is the amount of reconstruction undertaken during the period of occupancy. It is difficult to measure the full extent of this work and utterly impossible to identify all the influences which prompted it. Houses were torn down and replaced; partitions were built in; walls were changed and new levels established. First-story ceilings were braced to receive the additional weight of later rooms erected above.

Fully 30 per cent of the dwellings in the newer portion of the pueblo overlie the remains of unfinished or partially razed structures. On the outer northeast quarter of the village, there is a veritable maze of interlaced foundations that never supported the walls for which they were prepared. An enormous amount of labor was involved here. What operated to change the intentions of the builders?

It now appears that plans for a considerable addition to the village were suddenly altered after the work was well under way, and that the proposed outer tiers of rooms were drawn in to their present positions. Final solution of this puzzle, it is hoped, may follow additional excavations which are now in progress.

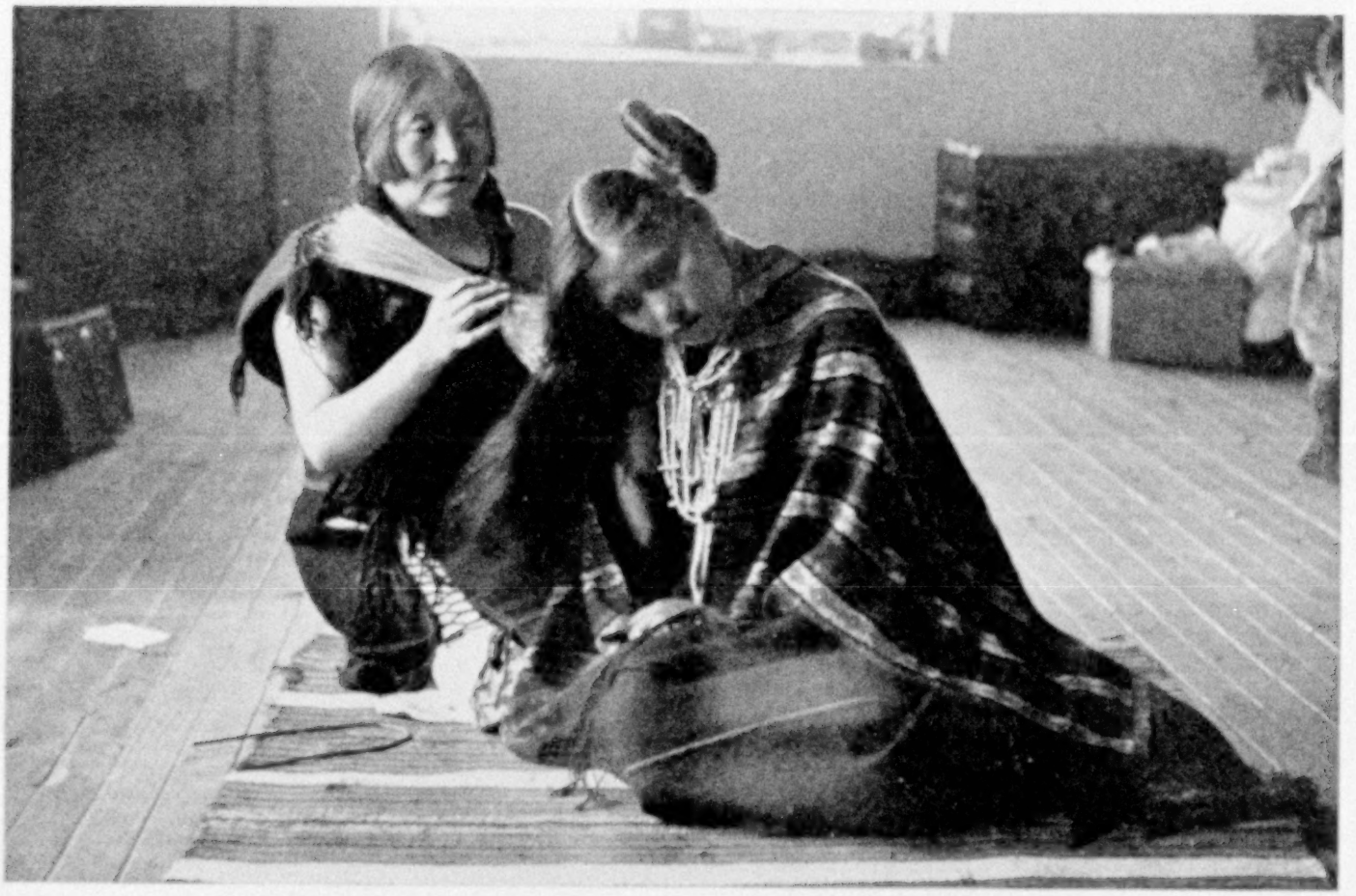
A COMANCHE WAR DANCE

The Comanche came into the Pueblo country from the north, where they were long noted as the finest horsemen of the plains and bore an enviable reputation for dash and courage. They are well built, possessed of a high sense of honor, and hold themselves superior to the other tribes with which they are associated.

Photographs by O. C. Havens

A ZUÑI CORN-GRINDING DANCE

This ceremony was a part of the intertribal Indian festivities held recently in Gallup, New Mexico.



Photograph by O. C. Havens

A HOPI HAIRDRESSER

Unmarried girls among the Hopi part their hair in the middle from the forehead to the nape of the neck, and arrange it in a large whorl above each ear, a very distinctive style symbolic of the squash-blossom. However, as the girls become educated this picturesque fashion is fast disappearing.

Those members of The Society who have followed the Pueblo Bonito explorations will recall that several types of masonry are visible in the ruin. The oldest and crudest of these is confined to the north and northwest sections; it is characteristic of a separate settlement of long standing and of irregular outline—a settlement which formed the nucleus of the great, terraced village we now call Pueblo Bonito.

The inhabitants of this older section were the original Bonitians. They formed a somewhat decadent community, since but few additional rooms were erected by them after their number had been increased by a larger group of near-strangers, who, having arrived by invitation, began to rebuild the town to suit their own fancies

NEWCOMERS WERE MASTERFUL, PROGRESSIVES

Abandoned dwellings of the old village were razed and replaced; in fact, the new structures, following more or less definite plans, actually absorbed and encompassed the older settlement.

These newcomers were progressives; they were masterful. To them we owe the far-famed Pueblo Bonito of later years, the Pueblo Bonito whose marvelous ruins now form a pass-key to that wealth of prehistory locked in the sands of our Southwestern States; whose very name—the City Beautiful—signifies the admiration in which it was held by another people living in another age.

These late arrivals were skillful potters, master builders, hewers of stone and wood. They erected retaining walls around the village refuse piles just to keep the potsherds and ashes from scattering too widely. They went unknown distances to fetch, upon their bare shoulders, the hundreds of heavy pine logs required in the houses they piled one upon another.

They changed, altered, and enlarged their pueblo with utter disregard for the physical labor involved. What they willed to do they did. They even had

Photograph by O. C. Havens

A DRUMMER OF ORAIBI

The Hopi are clever at making masks and other ceremonial paraphernalia from hides. On the shelf above the drummer's head are masks with their faces to the wall. Southwestern pueblo tribes enjoy long-drawn-out ceremonies, of which the Hopi have thirteen, each lasting nine days. Oraibi is the largest and most important of the villages of the Hopi, in northeastern Arizona. Before the establishment of a Spanish Franciscan mission here in 1629 it was said to have had 14,000 inhabitants.

Photograph by O. C. Havens

AN INDIAN TERRACED GARDEN: HOTEVILLA PUEBLO

Rain is a fugitive blessing in the Southwest, but, by terracing the slopes of the mesas and surrounding each small garden inclosure with low ridges of earth, the flood waters that roar down from the mesa tops following torrential midsummer showers are caught and held. By this system of inundation moisture is concentrated in the cultivated areas and gardening is made possible (see text, page 233).

the presumptuousness to erect a puny brace of sticks and stones to hold back 100,000 tons of solid rock that threatened to topple upon their dwellings (page 235).

It is this last colossal conceit—this most naïve feat of ancient American engineering—that gives Pueblo Bonito the name by which it is known throughout the entire Navajo reservation, *Tse-biya hani ahi*—Place-of-the-braced-up-cliff.

During the long period of time in which their invited guests dominated both the religious and secular life of the community, the original settlers of Pueblo Bonito continued quietly to occupy their corner of the village, pursuing their usual activities in the manner to which they had grown accustomed.

The latter were influenced, but to a slight degree only, by the more dominant culture about them. They had the visible example of superior masonry and profited by it when repairing the walls of their dwellings. They drew new elements into the ornamentation of earthenware vessels, yet kept their characteristic pottery forms and decorative motives.

These pioneer Bonitians maintained rectangular rather than circular kivas, yet they gradually introduced into their council chambers certain special features and furnishings more typical of the round rooms of their neighbors.

Such evidence of cultural influence is quite what one would expect under the circumstances; but it is far less easy to understand why this weakened group of original settlers should wish to remain in Pueblo Bonito after their more numerous and aggressive associates had departed. Theirs was a sinking ship, but they chose to remain with her.

MYSTERY STILL CLOAKS CAUSE FOR ABANDONMENT OF PUEBLO BONITO

As to the fundamental reason and the manner in which Pueblo Bonito was ultimately abandoned, we cannot be sure.

There may have been a single outpouring, a general exodus, like the Children of Israel's, or there may have been a piecemeal migration, a clan or two at a time. Disease may have cut its sudden swath, leaving terrifying thoughts in the minds of these primitive desert dwellers.

There may have been one cause or several. Of this much only are we certain: The Bonitians were being subjected to a constantly increasing pressure from nomadic, enemy peoples. We know that, seeking protection from these demoralizing attacks, the inhabitants sealed all outside doors and windows, thus making of their great community house a veritable fortress. The anxieties of defensive warfare may well have hastened the actual abandonment of the village.

Again, such warfare may have exterminated or reduced to captivity those few survivors of the original settlement who clung tenaciously to their ancestral home.

DWINDLING WATER SUPPLY MAY HAVE CAUSED MIGRATION

Evidence relating specifically to this last period of occupancy is meager and inconclusive. Perhaps the disturbed room burials uncovered last season represent hasty interment of bodies sacrificed in these final struggles. At least one of the defenders was shot through with an arrow; its flint point had been broken off in one of his lumbar vertebræ when the feathered shaft was pulled from the fatal wound.

Other possibilities remain. The water supply may have dwindled; there may have been successive years of drought, during which new crops were not matured; or, what is equally plausible, long-continued irrigation may have produced sterility in their cultivated fields. This latter, indeed, appears to have been a very important contributory factor.

Recent experiments in semi-desert areas of the Southwest show that irrigation water of a certain type tends to eliminate or wash out helpful chemicals from the soil, leaving behind too high a percentage of sodium bicarbonate. The latter has a hardening effect upon the soil and makes it impermeable to water.

During the course of The Society's explorations in Chaco Canyon, we have noticed repeatedly that shallow puddles of rain water sometimes stand for days without wetting the earth so much as an inch below the surface. By analysis of the soil in such places, it has been determined that black alkali is present to such an extent as to render agriculture practically impossible.

Since these salts are found to a depth of ten feet, it is highly probable that farming eventually became as hopeless in ancient times as it would be to-day.

Bonitian gardens were very likely located along the sandy margins of Chaco Canyon to profit most from such rain water as drained off the mesas; but if this water gradually destroyed the productivity of the soil, as it has elsewhere, even a small resident population would soon have found themselves in a very precarious position, threatened with failure of their chief means of livelihood.

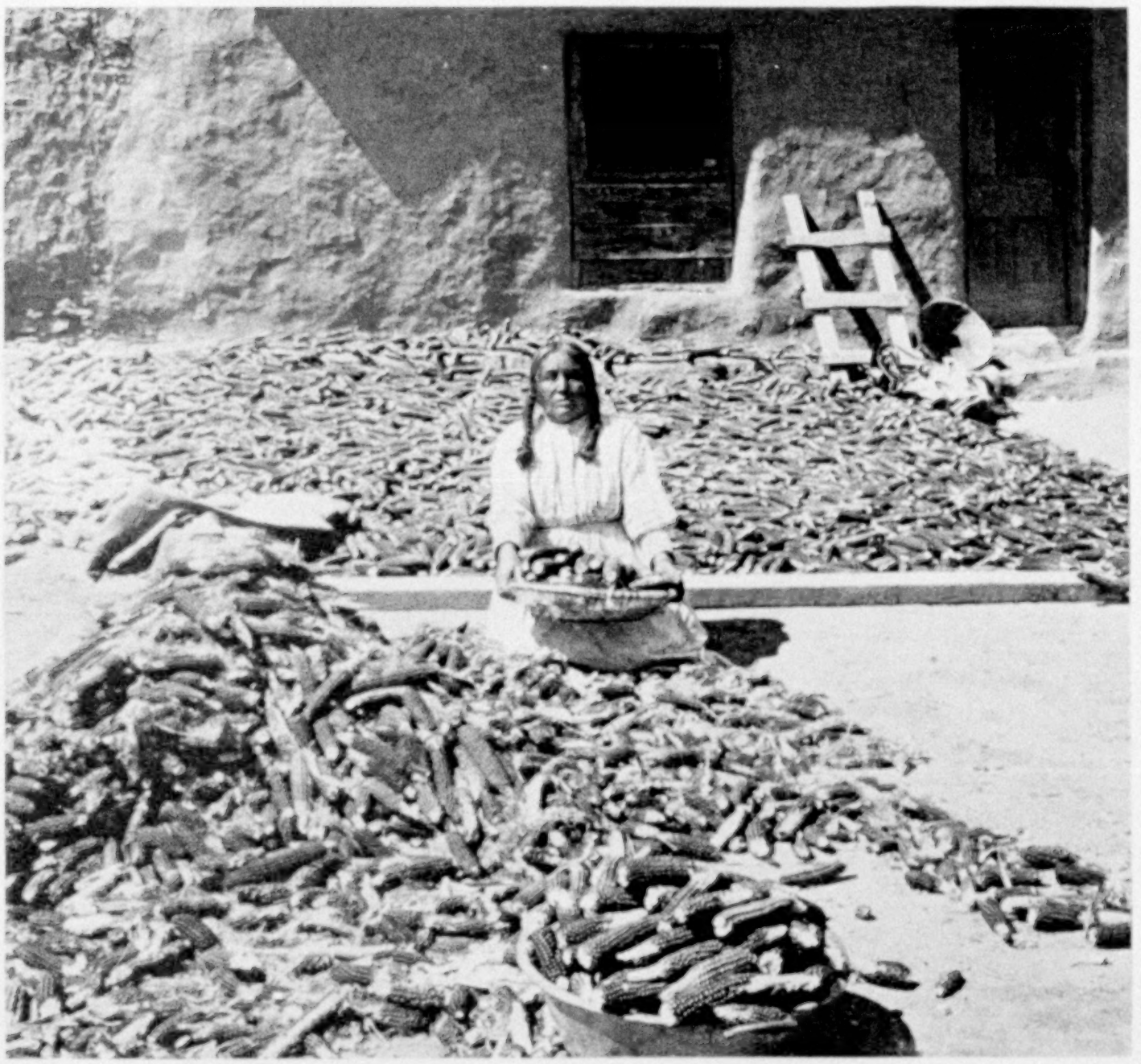
In this connection it should be remembered that Pueblo Bonito, at the height of its influence, sheltered no less than 1,200 people, almost wholly dependent upon agriculture. These villagers had no beasts of burden; with prowling enemies present they would not long have sought to cultivate distant farms or to support themselves through barter with other tribes.

THE LAST CHAPTER OF BONITIAN STORY IS LOST IN SHIFTING SANDS

In striving to reconstruct the history of a primitive people who vanished a thousand years ago without leaving any written record of themselves, one is forced repeatedly to call upon the imagination. No matter how much data may be recovered or how accurately they may be interpreted, the story is almost certain to be otherwise incomplete.

Trained eyes may read the secrets of broken pottery and fragmentary implements; experienced hands may piece together scattered bits of information until the significance of the whole is apparent; but when immeasurable gaps occur, it may or may not be possible to bridge them.

Through The Society's explorations the daily life of the prehistoric Bonitians has been at least partially reconstructed, but the impellent forces that hastened the abandonment of Pueblo Bonito and the



Photograph by O. C. Havens

GRADING AND DRYING CORN IN THE HOPI VILLAGE OF ORAIBI

Corn is the principal crop of the Hopi, as it undoubtedly was of the Bonitian. After the harvest, the ripened ears are neatly arranged in stacks, like so much firewood, in the storerooms at the back of the living quarters, until needed for meal.

destination of its builders after leaving their canyon home are problems which still await solution.

On these points no light has yet been shed. This last chapter of their fascinating story is apparently lost—lost in the shifting desert sands of the last thousand years.

Pueblo Bonito stands to-day a fitting memorial to its unknown and long-forgotten inhabitants. It stands a monument to their primitive genius, to their tenacity of purpose, to their ambition to erect a communal home in which each resident should find a deep and permanent interest. Theirs was an experiment in democracy—an experiment which ripened into full bloom and then withered—a full half millennium before our Pilgrim Fathers dared a similar venture on the bleak coasts of New England.

EXPLORING IN THE CANYON OF DEATH

Remains of a People Who Dwelt in Our Southwest at Least 4,000 Years Ago Are Revealed

By Earl H. Morris

A RUGGED gorge winds westward from the pine-clad slopes of the Chuska Range to lose itself in the multicolored wilderness of northeastern Arizona. Throughout the 25 miles of its length the mottled black-red walls rise, sheer or ragged, 500 to 1,000 feet above the tortuous ribbon of comparatively level land which forms the canyon floor.

The fingers of countless ages have caressed the cliffs and molded them into forms sublimely beautiful. Here, pillar-like, phantasmal colossi support a proportionate architrave; there, in massive stateliness, a mosque stands clear against the sky, while in the distance a detached pinnacle towers to a height of perhaps 1,000 feet, its lines light and graceful as those of the wing of a bird poised for flight.

A SLAUGHTER OF THE HELPLESS

Such is Cañon del Muerto, the Canyon of Death (see Color Plate VIII) and in the origin of the name there lies a story.

"In times past," as an Indian told me across the embers of our campfire, "the Navajo and the Mexicans were great enemies." Until, and even after, the occupation of the Southwestern Territories by the United States, they raided back and forth at every opportunity, each in constant dread of the other.

In the winter of 1804-05, as nearly as the year can be determined, the fighting men of a band of Navajo placed their women, children, and aged in a cave high in the rim rock, where they could not be seen by wayfarers in the canyon below, and rode away to follow their profession.

Before their return a party of Spanish soldiers, for Mexico was still a colony of Spain, marched down the canyon seeking vengeance. They were well past the cave when from the ledge an old woman, who in her girlhood had been a captive among the Mexicans, taunted them in their own tongue as men who walked without eyes. Thus advised of the hiding place, they encamped beneath it, cutting off all escape, and sent a detachment, by a long and circuitous route, to the mesa top.

Riflemen crept out on a jutting promontory, whence there was a view of the cave, and opened fire on the defenseless occupants. Many fell before the first volleys, and the remainder crept behind and between the blocks of stone which form a natural rampart along the brink of the ledge. Then the riflemen directed their fire against the sloping wall of the cave, depending upon an occasional deflected bullet to find its mark.

When the marksmen judged their end accomplished, they signaled to the watchers below. The latter climbed to the cave, crushed the skulls of the wounded with their gun butts, christened the gorge the Canyon of Death, to commemorate their "victory," and retreated into the night of time.

Because of a superstitious fear of the dead, since that day no Navajo has set foot upon the spot where nearly 100 of his tribesmen met their ignominious fate.

Although in recent years despoiled by white men, the cave still bears mute evidence of the tragedy—hundreds of white marks where bullets splashed against the cliff, bleached bones, and parts of ligament-bound skeletons lying in general disorder in the dust (see illustration, page 265).

WRESTING SECRETS FROM THE DEAD

This was only an episode in the history of Cañon del Muerto, a history written not in formal documents, but in the results of their occupation, left in the caves by the succession of peoples who for unnumbered centuries dwelt within.

Food substances, articles of dress, implements and weapons, domestic utensils, types of dwellings, and burial customs are the alphabet in which the story of people who knew not the art of writing is recorded; and these symbols the technique

Photograph by O. C. Havens

DRYING PEACHES IN THE HOPI VILLAGE OF ORAIBI: NORTHEASTERN ARIZONA

of the archeologist translates into the history of primitive culture.

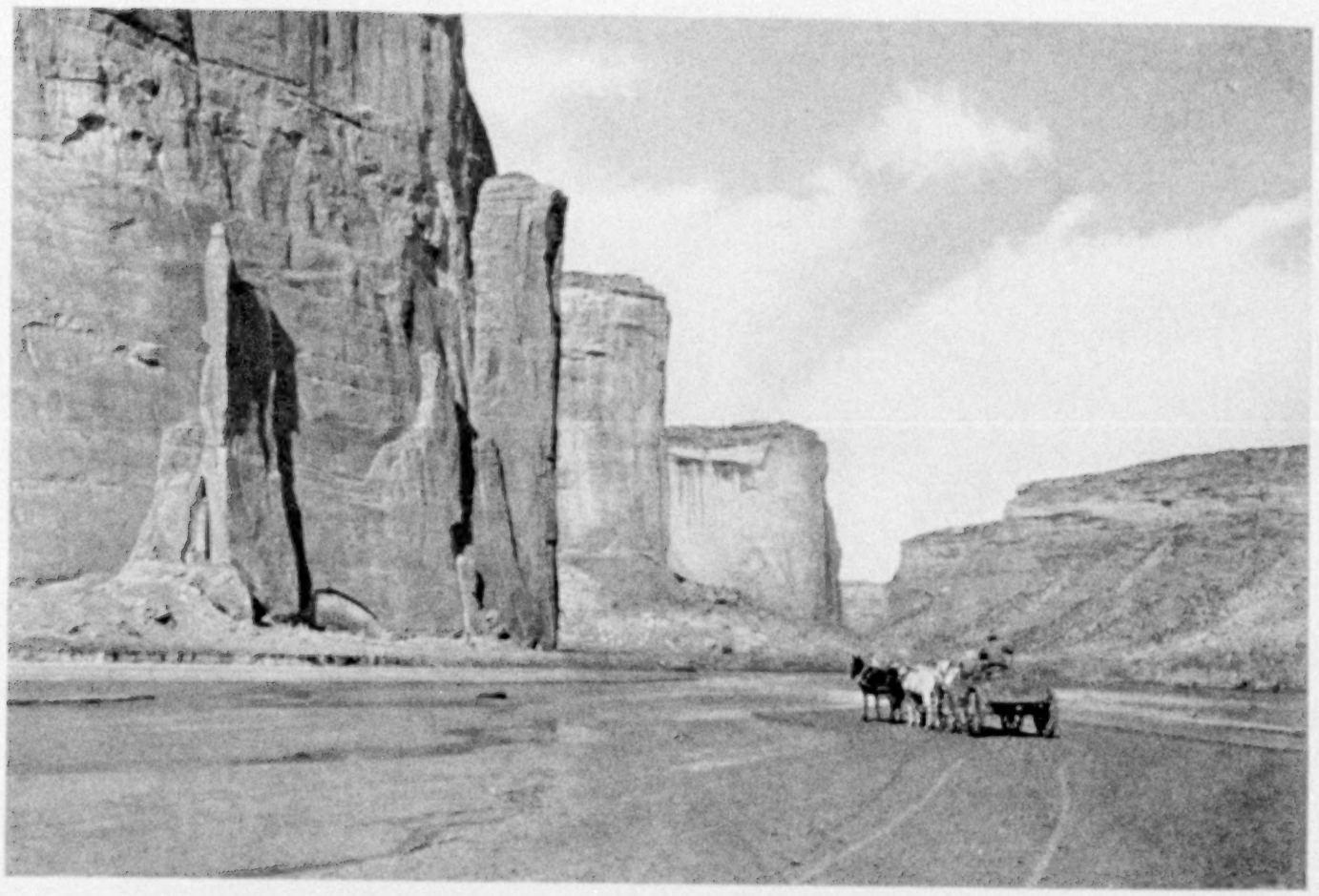
During the fall of 1923 I began the study of the prehistoric ruins in Cañon del Muerto for the American Museum of Natural History of New York City. On a bright September day our expedition encamped in front of Mummy Cave. In the latter there stands a typical cliff dwelling, a masonry structure of 80 rooms, in one place three stories in height (see pages 270 and 271).

From the front of the building a blanket of refuse, principally ashes and sweepings, spreads down over the sloping rock to the top of the natural talus, 100 feet below.

At one end of the refuse deposit the wind had uncovered human bones, and there we began to dig. The first skeletons were badly decayed, and the only objects found with them were stone pipes.

Farther in, beneath a covering of cedar bark, there lay the body of a man mummified by desiccation. Buckskin moccasins with an insole of cedar bark inclosed the feet, and spiral leggings of the same material extended to the knees. A broad sash of buckskin encircled the waist three times. One end fell like an apron to the middle of the thighs, while the other was tossed diagonally across the breast and over the left shoulder.

On the left wrist was a bracelet of shell beads, and by the right side a spear thrower. On the breast lay a wooden flageolet incrusted with white beads set in pitch, a sack made from the entire skin



Photograph by Edwin L. Wisherd

THE NATIONAL GEOGRAPHIC SOCIETY'S WAGON IN CAÑON DEL MUERTO

In connection with its work in the Chaco Canyon region, The Society sent a photographic party into the canyons of northeastern Arizona.

Photograph by Earl H. Morris

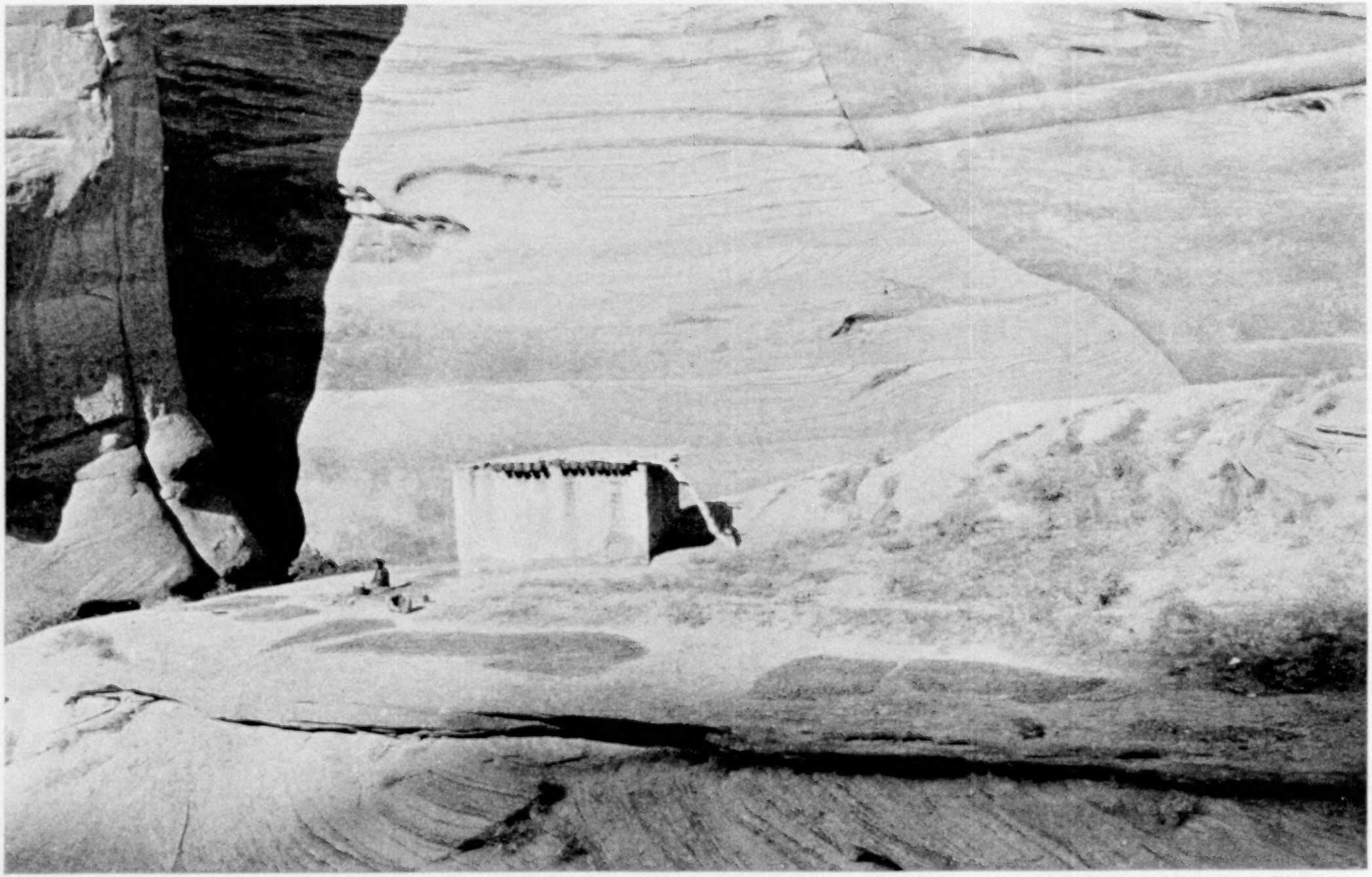
BULLET MARKS IN MASSACRE CAVE

When the Navajo who had not fallen before the first volleys crawled between and behind the blocks of stone which line the front of the cave, riflemen on the ledge high above them began shooting against the rear wall, depending upon deflected bullets to complete the work of extermination (see text, page 263). Although more than a century has passed since the Spaniards splashed their lead against the cliff, the marks are as white and fresh as if made but yesterday.

Photograph by Edwin L. Wisherd

LOOKING DOWN CAÑON DEL MUERTO FROM MUMMY CAVE

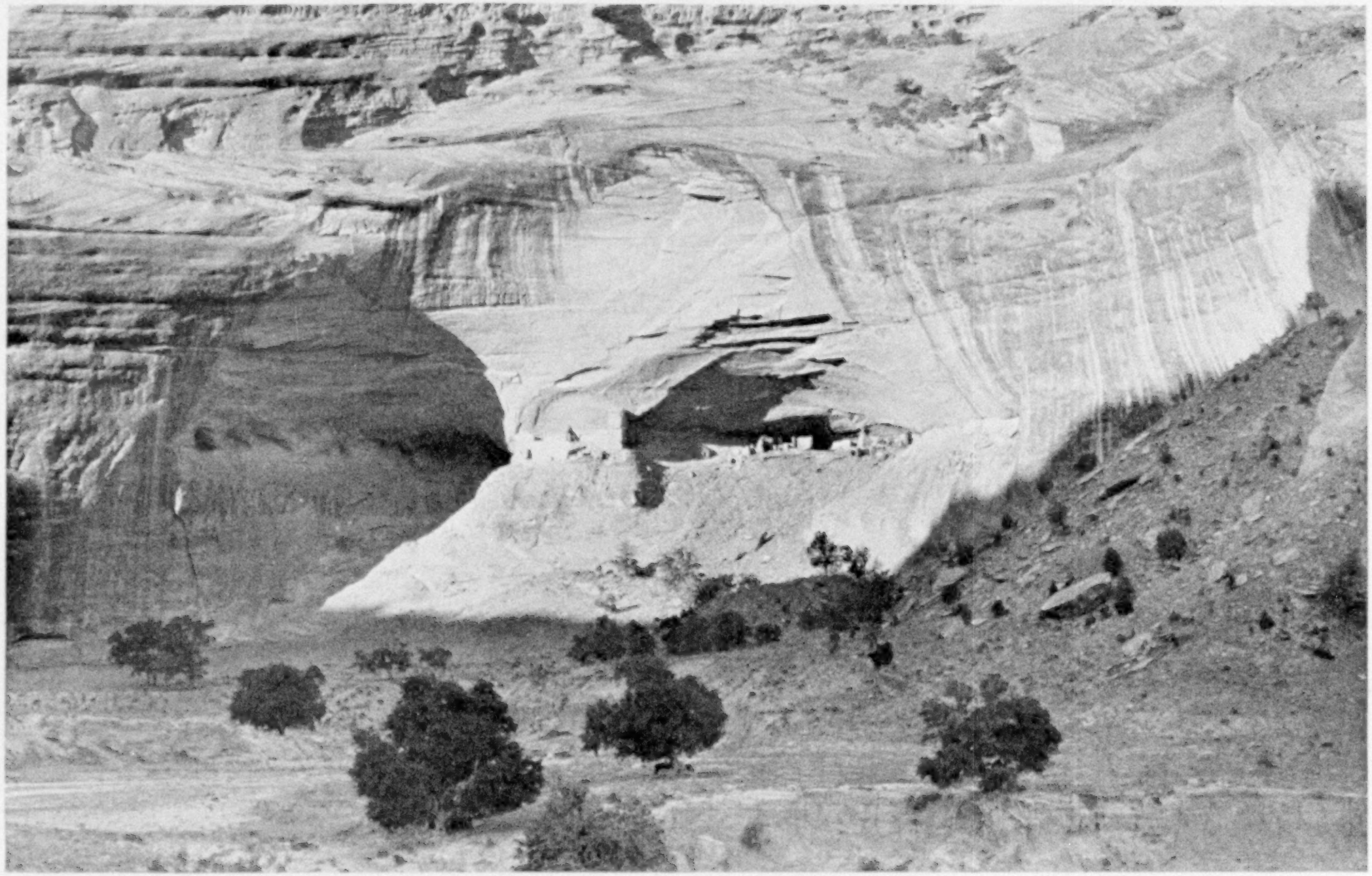
In this cave are the remains of a large cliff dwelling (see pages 268 and 269) which yielded many articles of dress, implements, and domestic utensils—"symbols which the archeologist translates into the history of primitive culture."



Photograph by Edwin L. Wisherd

A NAVAJO WOMAN DRYING PEACHES: CAÑON DEL MUERTO

Because of a superstitious fear of the dead, neither this woman nor any of her tribe has ever set foot in the cave in this canyon, where nearly 100 of her people were shot down more than a century ago (see text, page 263).



Photograph by Edwin L. Wisherd

A PREHISTORIC CLIFF VILLAGE IN MUMMY CAVE (SEE, ALSO, OPPOSITE PAGE)

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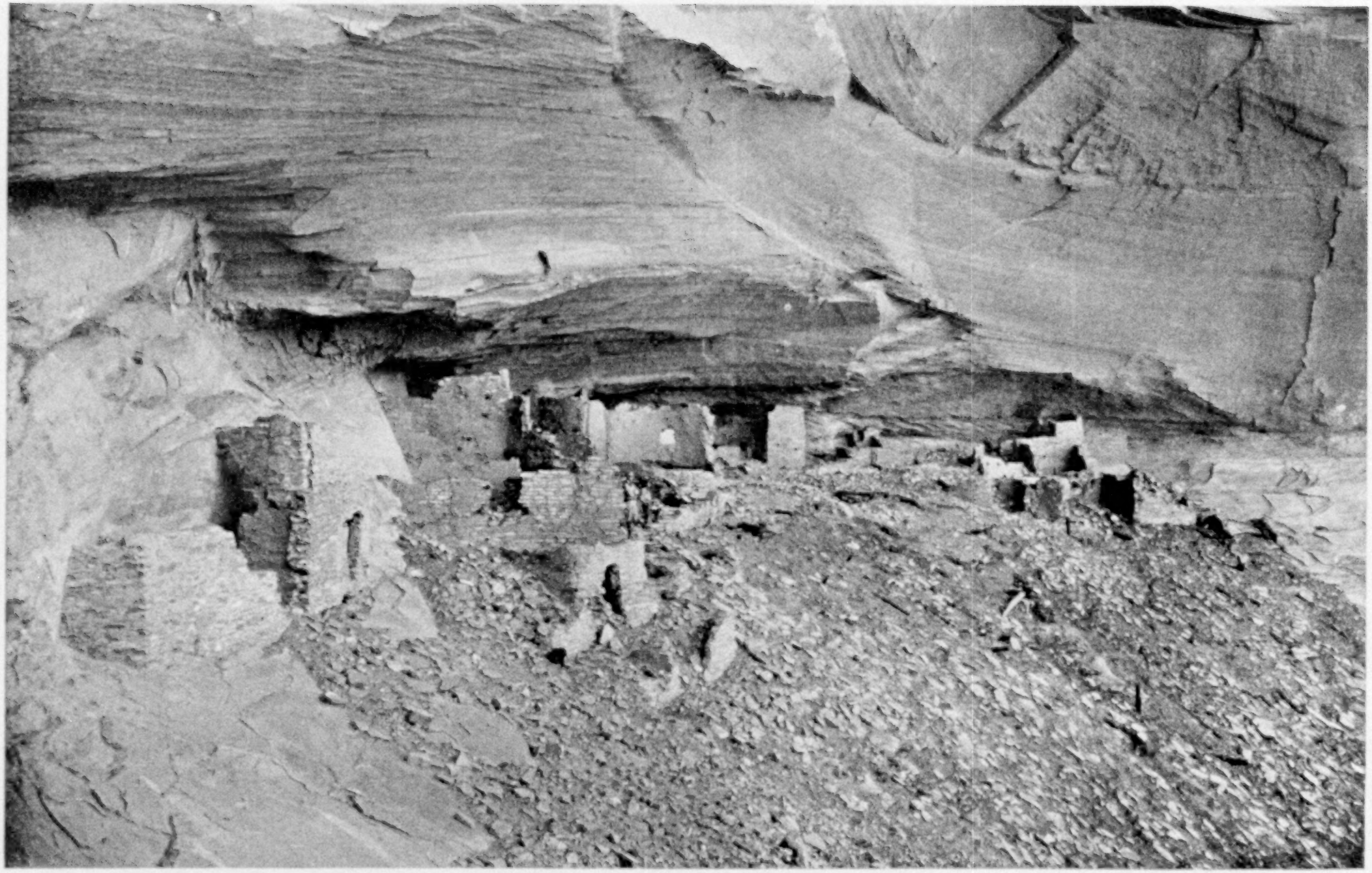
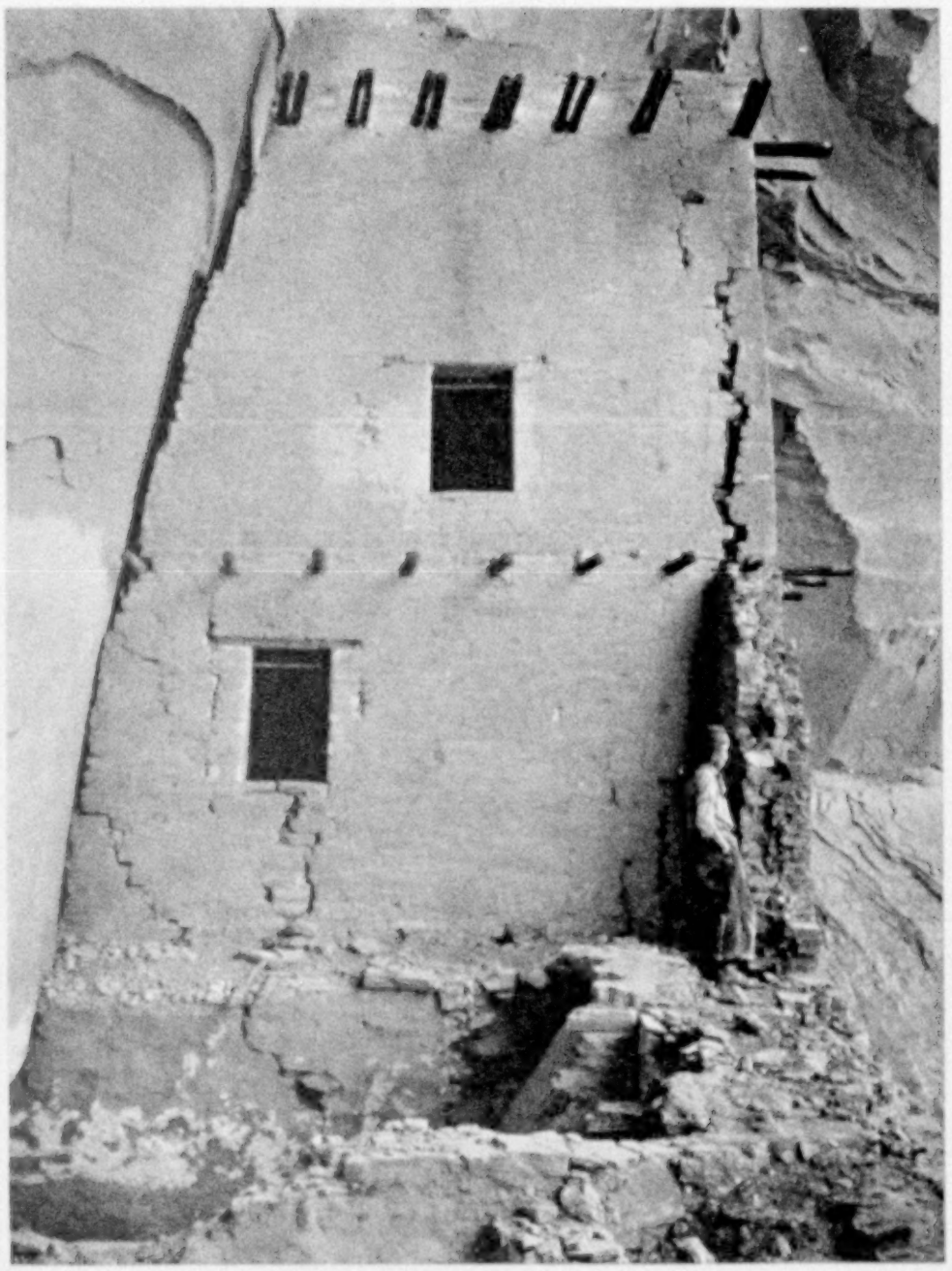


Photograph by Edwin L. Wisherd

A DETAILED VIEW OF THE PREHISTORIC CLIFF VILLAGE IN MUMMY CAVE (SEE, ALSO, PRECEDING PAGE)



Photograph by Edwin L. Wisherd

A THREE-STORY CLIFF DWELLING IN MUMMY CAVE
(SEE TEXT, PAGE 264)

of a small animal, containing a pipe and smoking materials, and a number of bone implements.

A basket lay beneath the head, another was inverted over it, and a blanket made of cords wrapped with strips of rabbit skin enveloped the entire frame. Evidently, when animate, the shrunken body had been that of an important personage in the ancient community.

EARS OF CORN THOUSANDS OF YEARS OLD

As we trenched upward, following the rock, which sloped at an angle of 45 degrees, we cut through various cribbings of stones, logs, and brush built as retaining walls to hold back the refuse and thus increase the area of the cave floor.

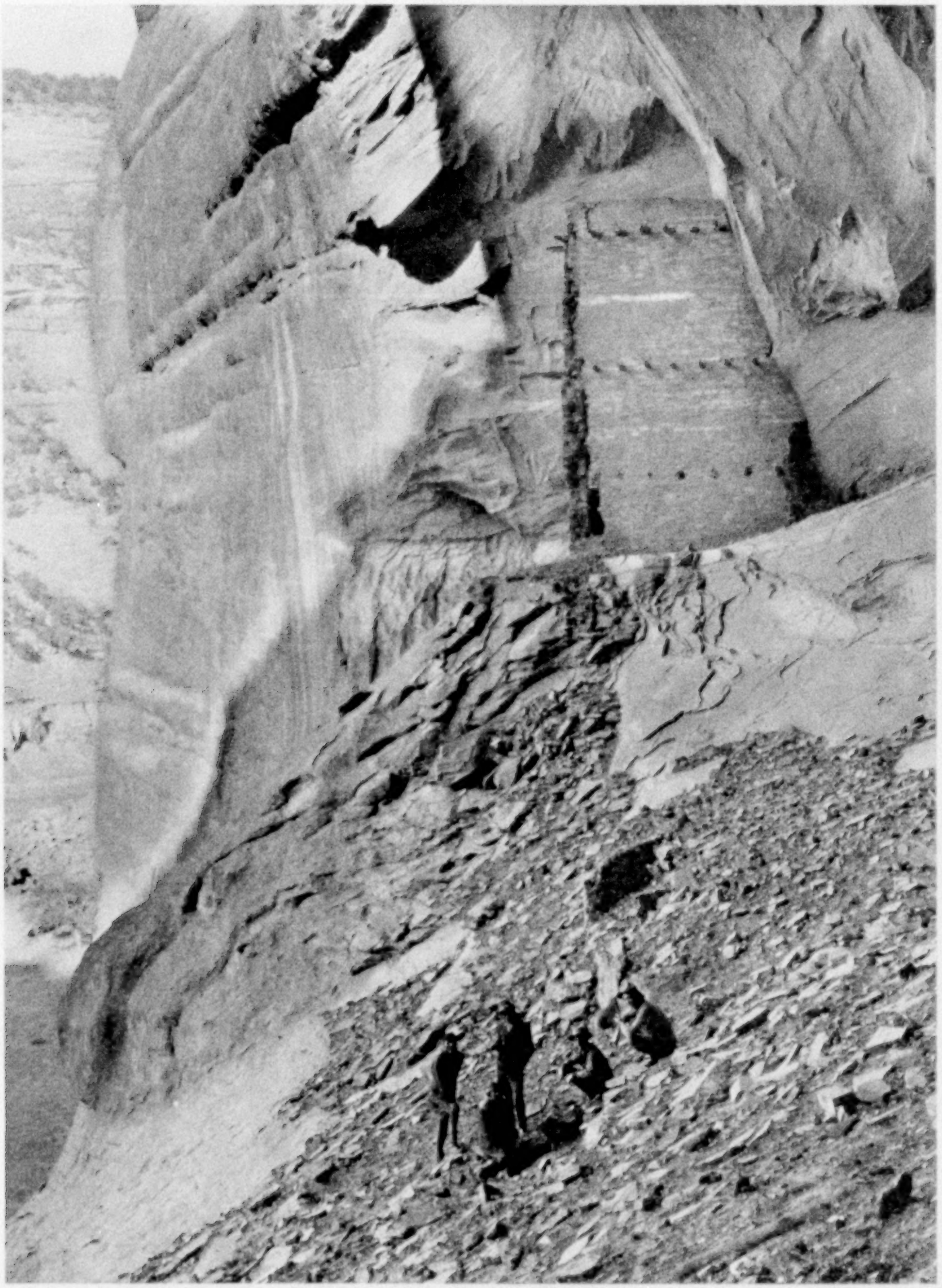
Eventually we came to a large series of storage bins. These were rude inclosures of irregular form from two to six feet in diameter and of varying depth. Large, thin slabs of stone set on edge composed the walls, the joints of which were sealed with mud made tough with shredded bark, reed leaves, or corn-husks. The roofs of only two were in place.

Resting upon the tops of the slabs in each case was a jug-like neck of adobe reinforced with sticks. The covers were slabs of stone worked down to nearly circular form. In one of the storage cysts there were 700 ears of corn, which, although thousands of years old, were as bright and fresh as if recently gathered.

In another there was a heap of slender gourds of the kind from which bottles and dippers were made, and in a third a quantity of seeds of a variety which the Navajo still grind as a substitute for flour.

As the rubbish resulting from occupation accumulated in the cave, the cysts farthest down the slope were allowed to become filled with it, and contained, naturally enough, many discarded objects. In such places we found hundreds of cloth sandals, many of them handsomely ornamented both in colors and raised weaving; baskets, arrows, knives, agricultural implements, and a variety of minor objects too numerous for individual mention.

In the center of each cluster of storage cysts there was a dwelling chamber, a rudely circular structure 12 to 25 feet in



Photograph by Edwin L. Wisherd

TWO-STORY CLIFF HOUSE IN MUMMY CAVE

From the front of the dwelling, a masonry structure of 80 rooms, a blanket of refuse spreads down over the sloping rock for a distance of 100 feet (see text, page 264).

Photograph by Earl H. Morris

A CAVE SANCTUARY

Often the inhabitants of the caves disturbed and destroyed the graves and dwellings of their predecessors. Here, in the construction of a masonry kiva, a ceremonial chamber, the cliff dwellers dug down through a previously existent slab house. The part of the latter which was not demolished they made use of as an enlargement of the underground room.

diameter. The walls had been of posts set leaning inward, and plastered over with mud, and the roofs of logs covered with earth. Fire—perhaps accidental, perhaps incendiary—had destroyed one of these rooms and with it the possessions of its occupants.

On the smooth earth floor surrounding the sunken fireplace were several pottery vessels, and elsewhere lay charred baskets, sandals, planting sticks, and practically every sort of article manufactured by the inhabitants.

Beneath the masonry cliff dwelling three culture levels were recognizable (see text, page 300).

A MAGNIFICENT MOSAIC ORNAMENT FOUND ON BREAST OF A MUMMY

Around the corner of the cliff from Mummy Cave was a cemetery. Bones lying about the mouth of an animal's burrow gave the clew, and we set to work with the expectation of rich finds. The bubble of our hopes, however, was soon punctured, for destruction had preceded us. A deep recess had been packed full of bodies of all ages, accompanied by quantities of burial offerings, enough of them at least to transform the spot into a charnel place, when fire of unknown origin gained access to the grotto.

For days we worked through an 18-inch layer of calcined bones smoked black or burned an ashy white and more brittle than icicles. There must have been more than 100 bodies in the original heap.

The meager fragments of specimens recovered from the wreckage poorly repaid our efforts, but the unexpected, which always holds a beckoning finger before the archeologist, brought us our reward in the end.

In front of the burned area a pit had been dug in the talus and three bodies placed in it. They lay back downward, one on top of the other. As I was removing the earth from the breast of the second, there were glints of blue in the mold upon my trowel.

A few strokes with a brush laid bare a magnificent mosaic ornament which had been worn around the neck. It was a large, skillfully fashioned ring of hard wood solidly incrusted with turquoise set in gum, each piece highly polished and accurately shaped to the space it was to occupy (see illustration to right).

A mouse had dug its burrow past the pendant and in so doing had detached a few of the stones. These were recovered by passing the adjacent earth through a fine screen.

Altogether apart from its intrinsic beauty, this pendant was the most ancient piece of mosaic work thus far discovered in the Southwest; hence the little group of excavators gloated over it as if it had been a king's ransom.

A few moments later we stared at each other in blank astonishment, for on the breast of the third skeleton there lay a second pendant precisely like the first, except that there was included among the mosaic elements a large rectangle of iridescent abalone shell.

Photograph courtesy American Museum of Natural History

A TURQUOISE MOSAIC PENDANT

This breast ornament, 3¼ inches in diameter, made of turquoise set on wood with gum, is the most ancient mosaic thus far found in the Southwest. It was preserved in recoverable condition as if by a miracle, for the skeleton with which it was found was so badly decayed that the bones could be rubbed to powder between the thumb and forefinger.

A CAVE DISCOVERED HIGH UP IN CANYON WALL

While we were still at work on the "boneyard," as we called the charnel place, my wife reported the existence of an obscure cave in a side canyon not far from camp. With the binoculars a line of mountain sheep and human figures, painted in white on the rear wall, could be discerned, proving that the cave had been occupied (see page 292).

A half hour's climb brought us directly beneath it, but face to face with a ledge 30 feet in height, worn smooth by the sandstorms of ages. The aborigines had pecked foot-holes in the rock, but these were so badly weathered that they were no longer of any use.

The one of us deemed of least account in mundane affairs was called upon to make the ascent. This he did, lying flat against the rock, working himself for-

ward inch by inch with his hands, and depending upon friction to keep him from slipping. Once on top, he tied a rope to the butt of a stunted tree, and, with this to hold to, the others clambered up without difficulty.

A moment later we were in the cave, looking out upon a scene never before beheld by human eyes; never before, because ledges had crashed down and generations of trees had grown and rotted since the last of the ancients departed.

CHILDREN'S BODIES PACKED LIKE SARDINES IN A GRAVE

Turns in the canyon cut off the view to the left and right, with the effect that below us lay a vast pit, its slopes cluttered with jagged blocks of stone and dotted here and there with gnarled cedar trees. At the very bottom, along the drainage course, there was a crooked line of very large spruces, so distant that they seemed like parlor Christmas trees. Smaller conifers fringed the rim rock opposite us, and above its towering red expanse there showed a ribbon of clear blue sky (see page 293).

There were a few intact rooms at one end of the cave, fallen masonry covering most of its area, and retaining walls, bastionlike, at the front of it. Where two of these met at a sharp angle, a pair of mummified feet protruded from the débris.

The tightly folded body was wrapped in a feather-cloth blanket. Three slender poles lay lengthwise above it and three shorter ones in the opposite direction. Upon these was spread a mat made of reed stems, which in turn was covered by one of neatly plaited rushes.

On the left wrist there was a bead bracelet composed of lignite disks one-twenty-fifth of an inch in diameter, and at the right of the head were a pottery bowl and drinking vessel. In a niche at the back of the cave were two handsome vessels—a large one, a dull-white, flat-topped vase, with vivid black decoration; the other a red, spherical canteen provided with two loop handles, and a bail braided from strands of human hair.

Some matron in the old days had filled these vessels with dried sunflower petals and hidden them away against the future—a future which for her never dawned.

The largest cave in Cañon del Muerto was three miles below our camp. It was a blustery morning late in October when we set out, each with a backload of tools, cameras, and what not, to begin work there.

On the way we were not permitted to forget a baconless breakfast, for every now and then our own footprints blotted out those of the bear that during the previous night had devoured our last slab of meat which had been left hanging from the limb of a tree just outside the tent door. Once within the great cave, however, so minor a point soon passed from mind.

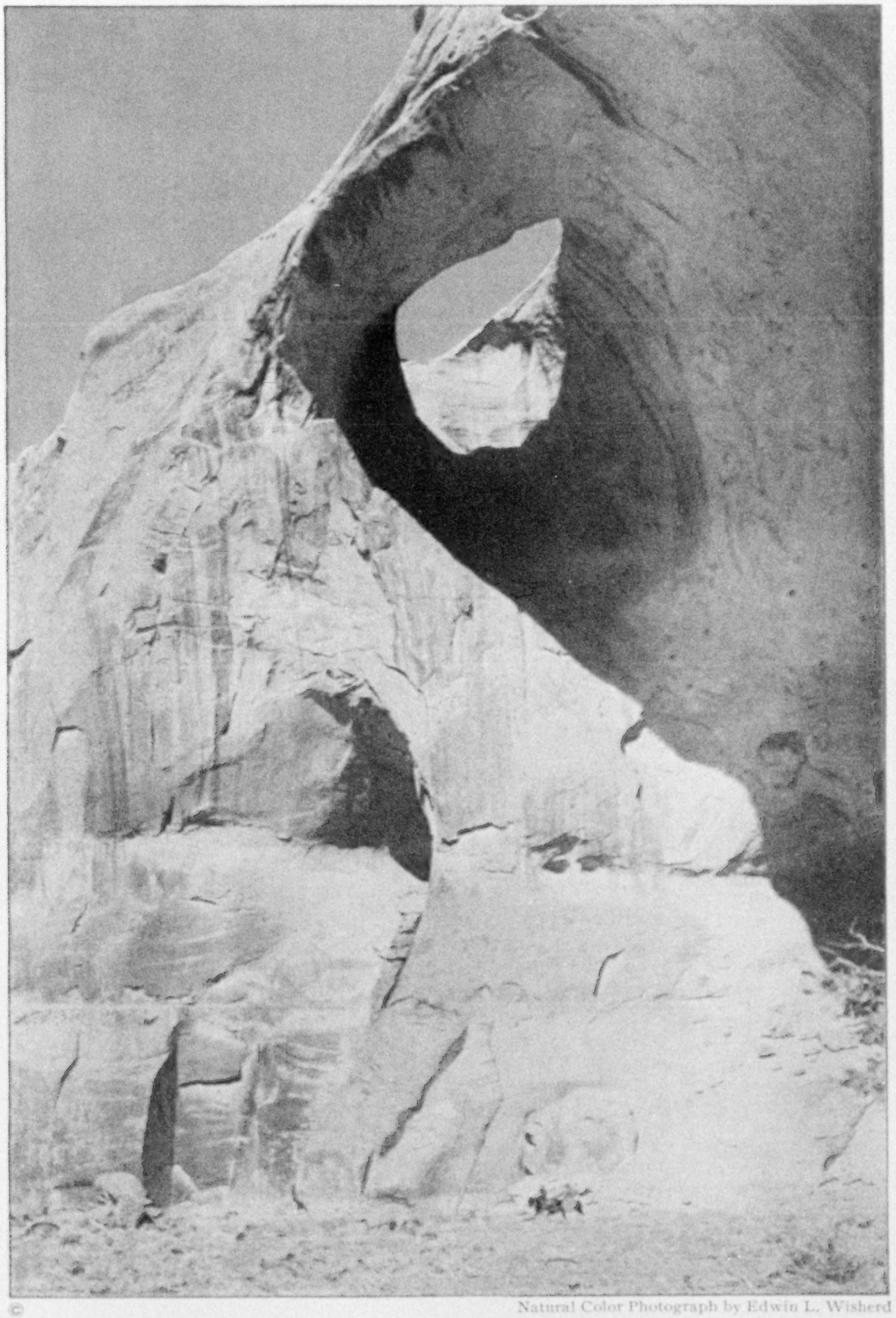
Near the western end of the 1,100-foot shelter the corner of a slab cyst like those in Mummy Cave was visible in the bank of a pit opened by some relic-hunter.

I thrust my shovel into the débris which filled it, and when I raised the blade there was the skull of a child upon it. The cyst was triangular, the sides being three feet in length and the base three and a half feet. It appeared to have been completely filled with the bodies of infants and small children. Each one was wrapped in a padlike mass of soft fiber made from leaves of the yucca plant and shrouded either in a fur or feather-cloth blanket. They were packed in as tightly as sardines in a tin.

After I had removed the 14th, my fingers touched a corrugated surface which at first I thought to be the ribs of a shrunken body. When the dust was brushed away it proved to be the side of a basket so large that had it been two inches greater in diameter it could not have been placed in the cyst. Inside it were the skeletons of four more children, two of them with bracelets on the left wrist, each a strand of white beads interspersed with pendants of abalone shell.

AN ANCIENT GRAVE ROBBER LEAVES A CLEW

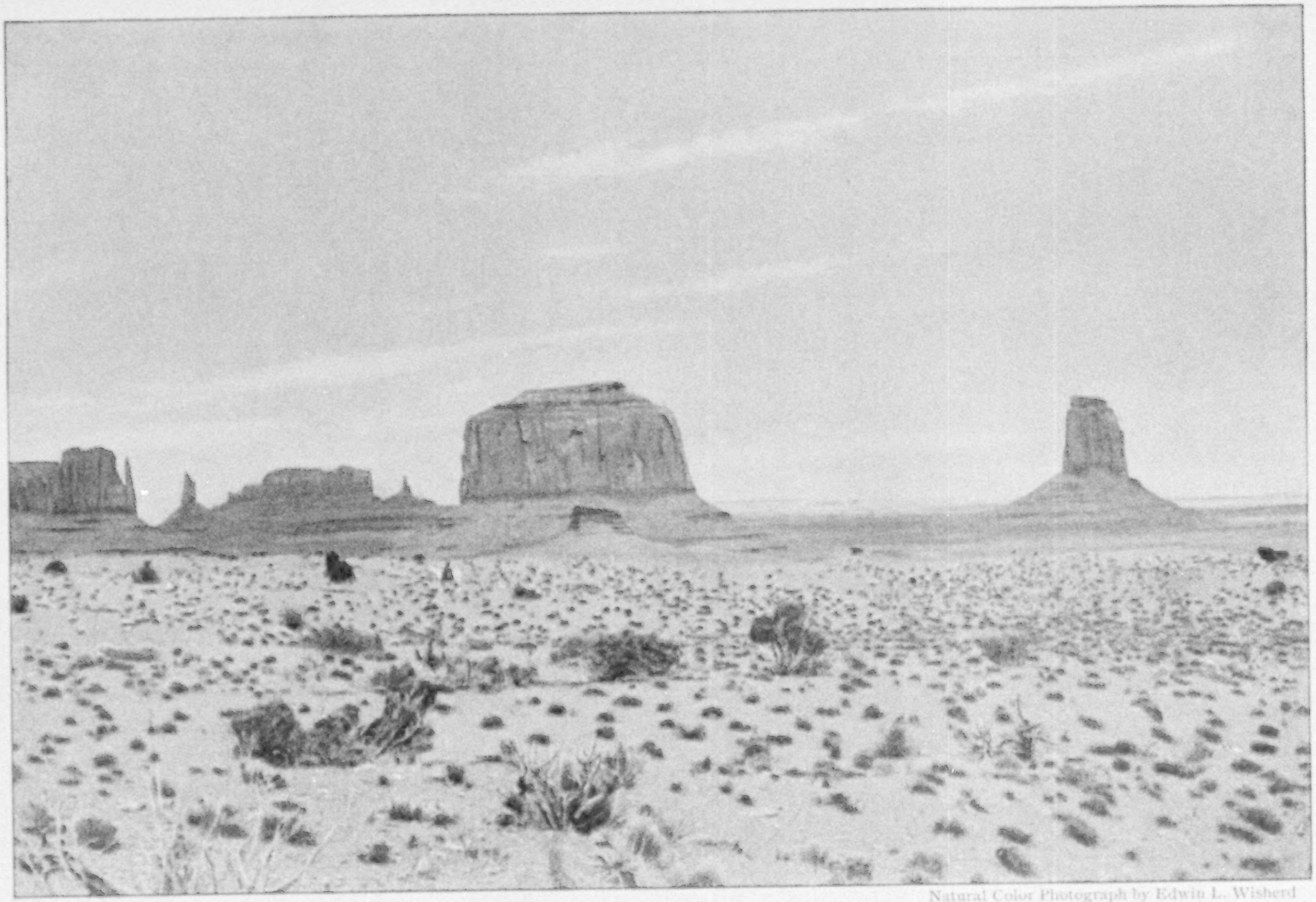
The neighboring areas were literally full of graves. In several the bodies were so well preserved that the features appeared as lifelike as those of the mummies of the Pharaohs. When we lifted the one shown in the accompanying illustration



© Natural Color Photograph by Edwin L. Wisherd

IN THE LAND OF THE NAVAJO

The red canyon walls of northern Arizona hurl back amplified echoes of the shouts of Indian horsemen. Note the two mounted men at the base of the cliff.



Natural Color Photograph by Edwin L. Wisherd

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PLAYGROUND OF THE DESERT GODS

Stretching for miles along the Utah-Arizona border northwest of Cañon del Muerto, sunlit Monument Valley becomes a veritable kaleidoscope, as fleeting clouds paint its red buttes purple and blend its far horizon with a turquoise sky.

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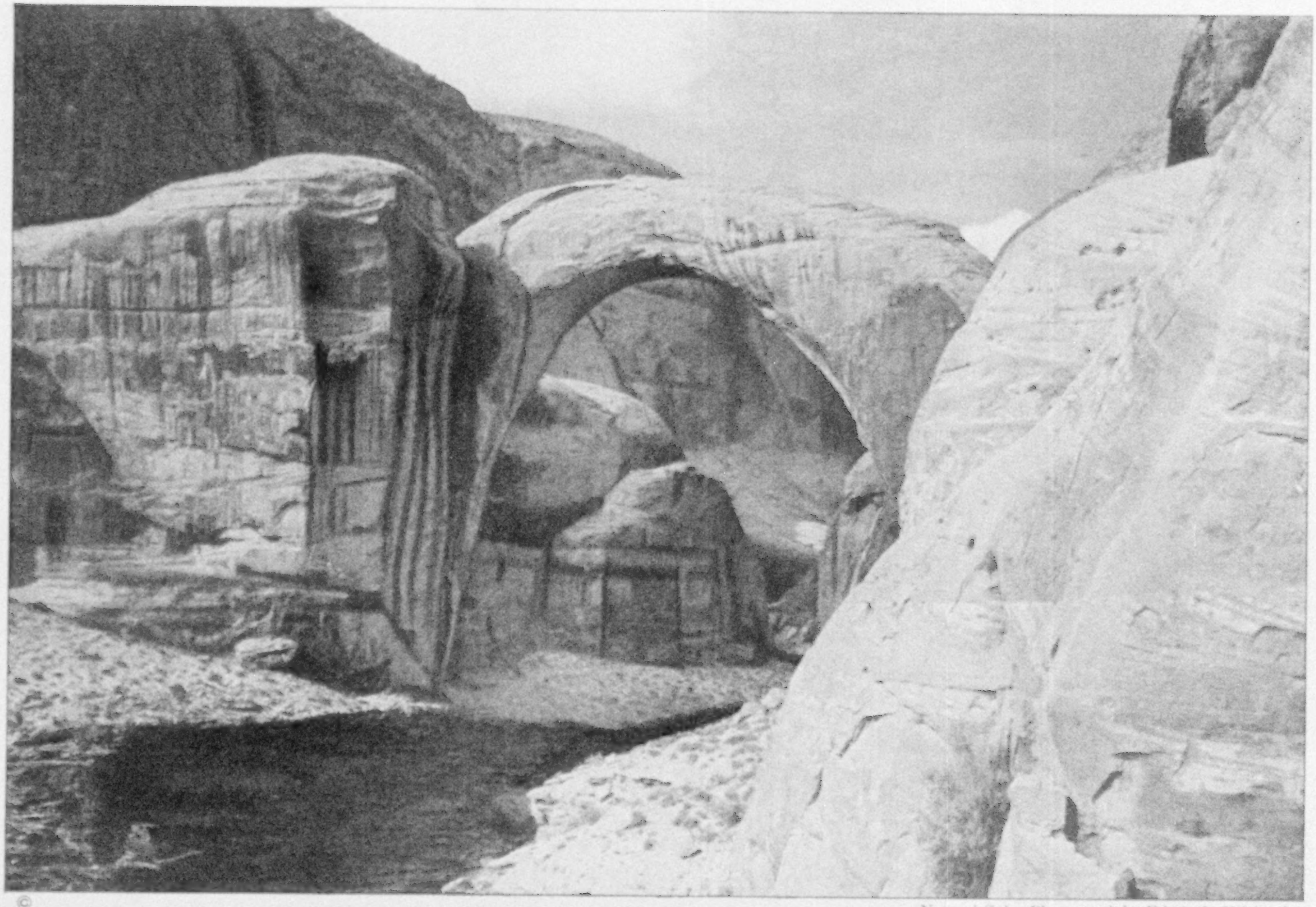

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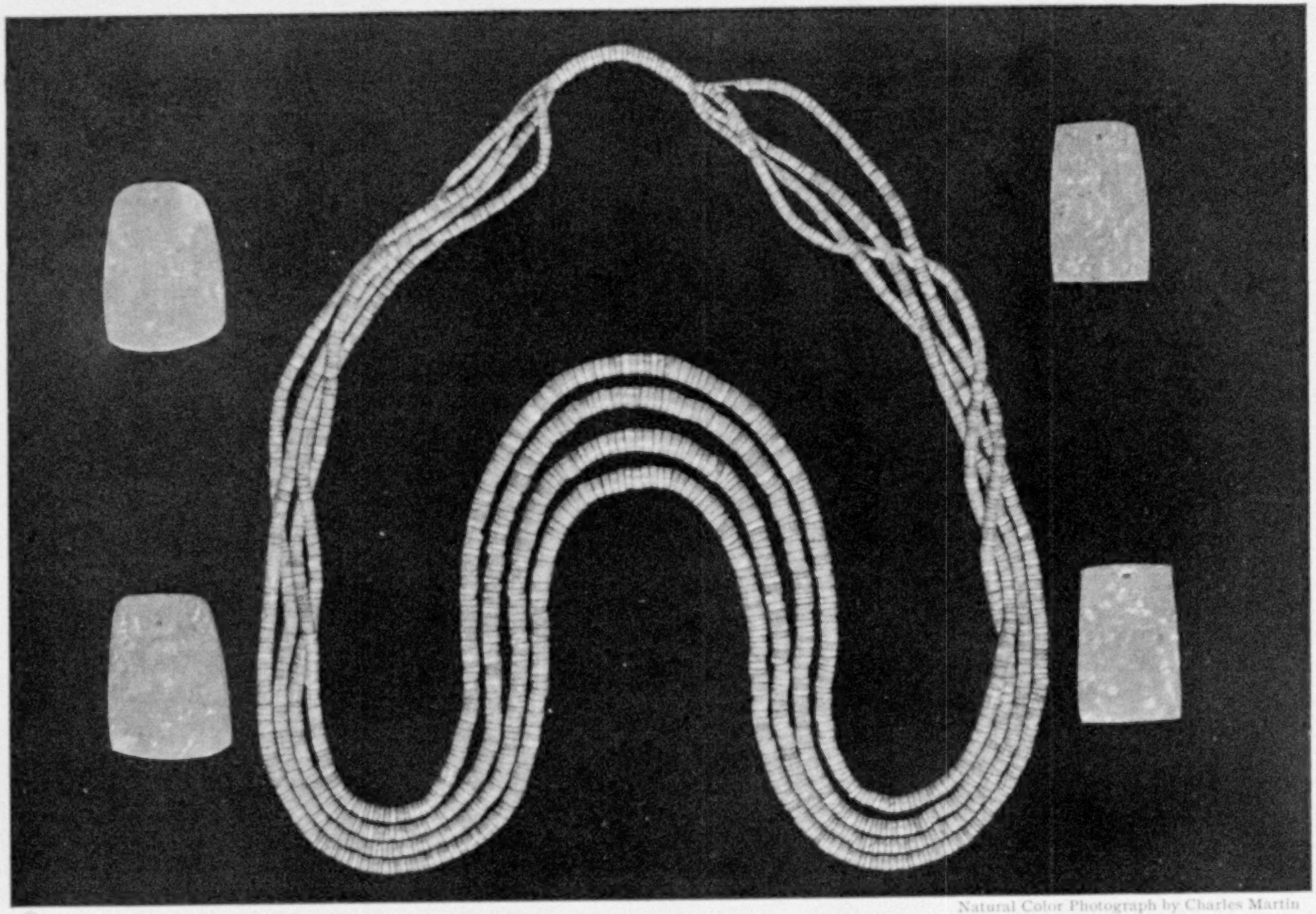
THE RAINBOW ARCH, LARGEST OF THE WORLD'S NATURAL BRIDGES

It was Professor Byron Cummings, now leader of the National Geographic Society Cuicuilco, Mexico, Expedition, who in 1909 led his party of young explorers across the desert trails of northern Arizona, around the rocky slopes of Navajo Mountain to the discovery of Rainbow Bridge, one of the most marvelous and awe-inspiring works of Nature to be found in North America (see the National Geographic Magazine for February, 1910, and February, 1923).



Natural Color Photograph by Charles Martin

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TURQUOISE NECKLACE AND EAR PENDANTS FROM PUEBLO BONITO

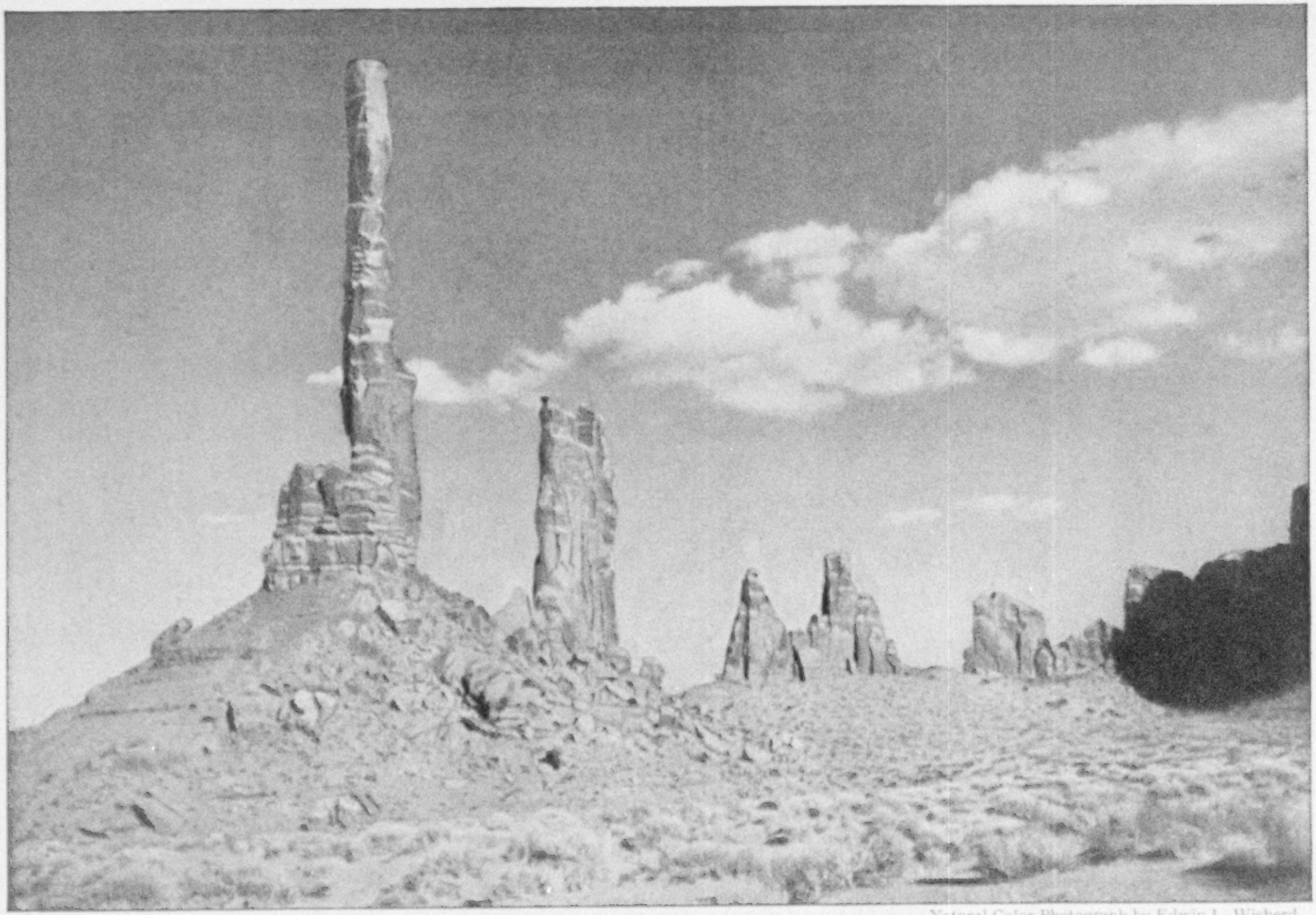
These incomparable ornaments were the pride and joy of an Indian who lived in Pueblo Bonito a full thousand years ago. They were discovered, buried under 15 feet of sand and débris, by a National Geographic Society Expedition in 1924; they form the only complete set of their kind known in the museums of the world to-day (see "Everyday Life in Pueblo Bonito" in this number of the National Geographic Magazine).

XUM

© Natural Color Photograph by Edwin L. Wisherd

PUEBLO BONITO, NEW MEXICO, IN SEPTEMBER, 1923

When the National Geographic Society began its exploration of this prehistoric Indian village in 1921, it presented much the same appearance as that unexcavated portion at the extreme right. The entire ruin has now been laid bare and a new chapter added to the history of America prior to the Spanish conquest.



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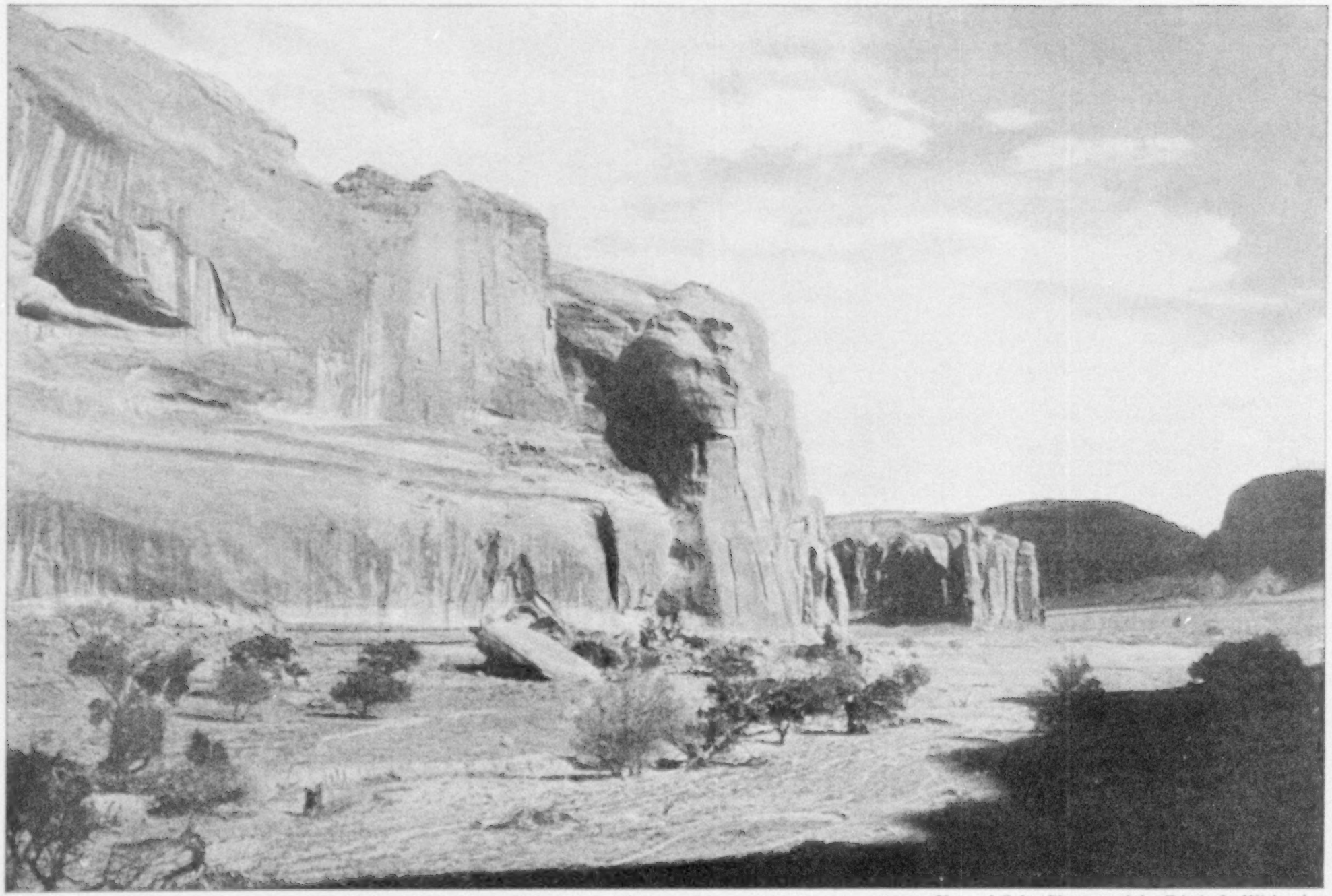
ROCK FINGERS POINTING TO THE GLORY OF ARIZONA SKIES

The borders of Monument Valley are marked by colossal buttes and red sandstone pinnacles that tower 800 feet above the shifting desert sand.



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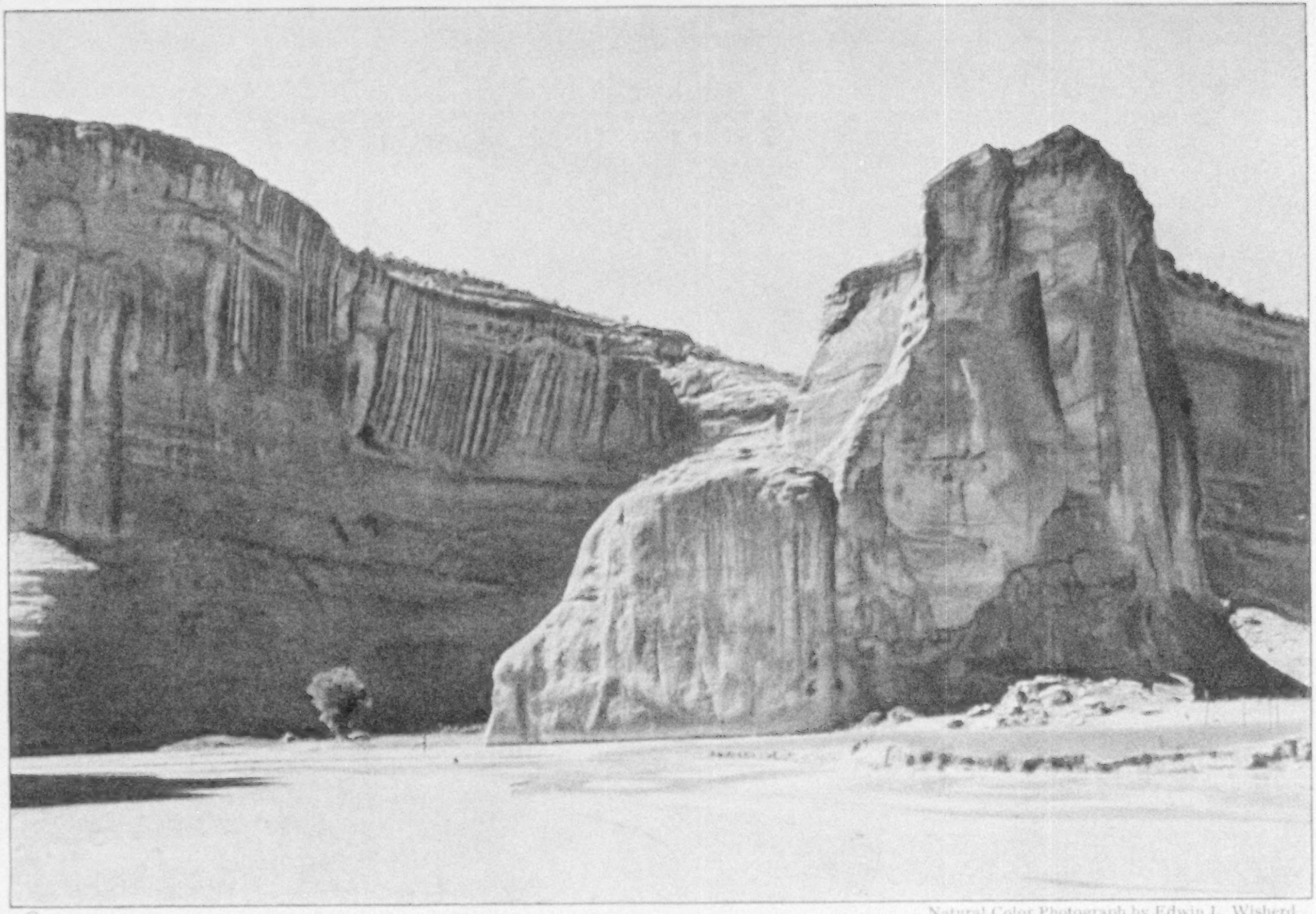
ON THE TRAIL TO RAINBOW NATURAL BRIDGE

From Kayenta, Arizona, the Rainbow Bridge trail leads through silent canyons in whose sheer red walls rounded caves furnished village sites for prehistoric Cliff Dwellers.



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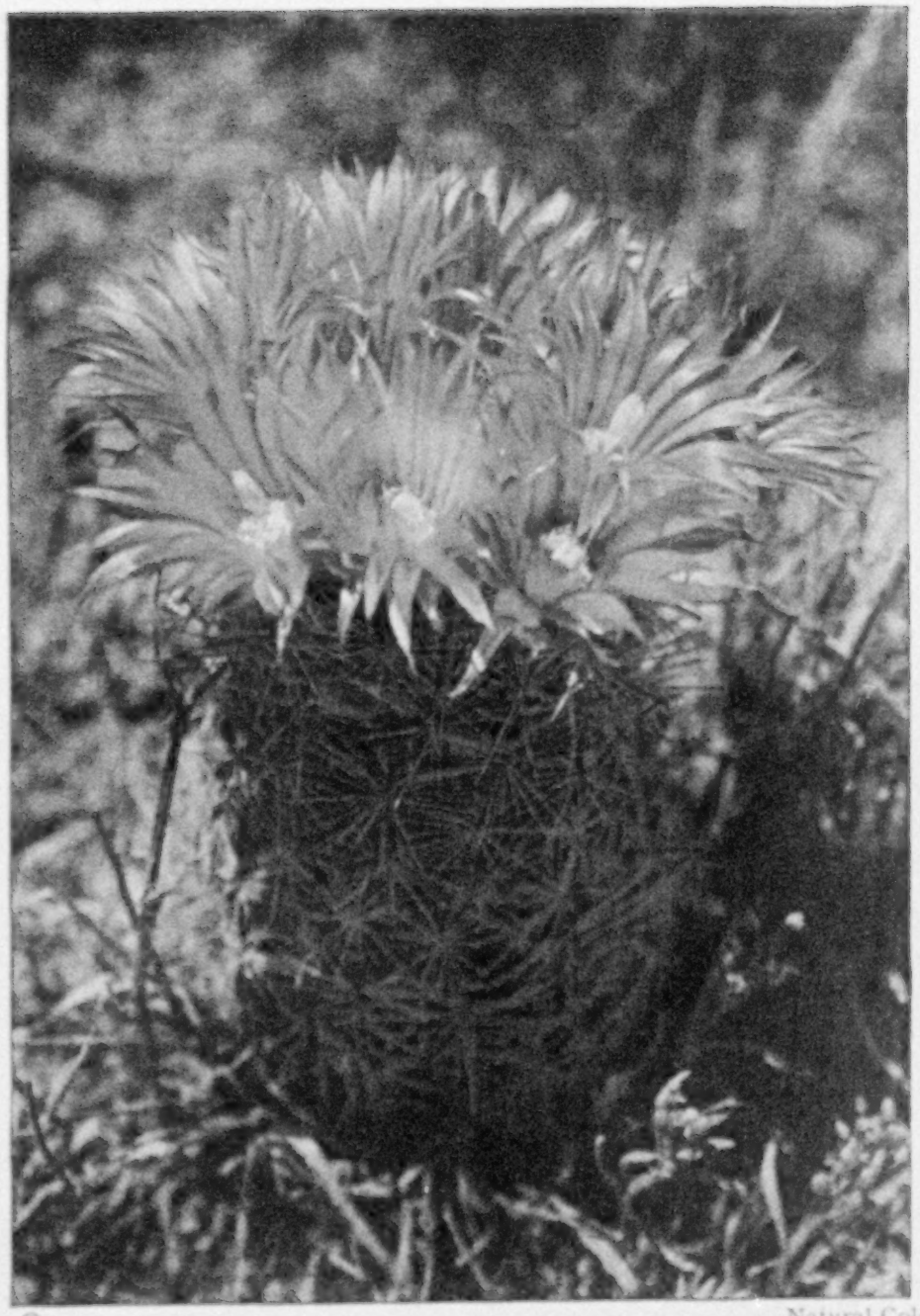
CAÑON DEL MUERTO

The Canyon of Death was so named after Mexican villagers had surrounded and killed a large number of Navajo, in retaliation for repeated Indian raids against settlements far to the south (see article in this number of the National Geographic Magazine). Note the man in the middle distance.



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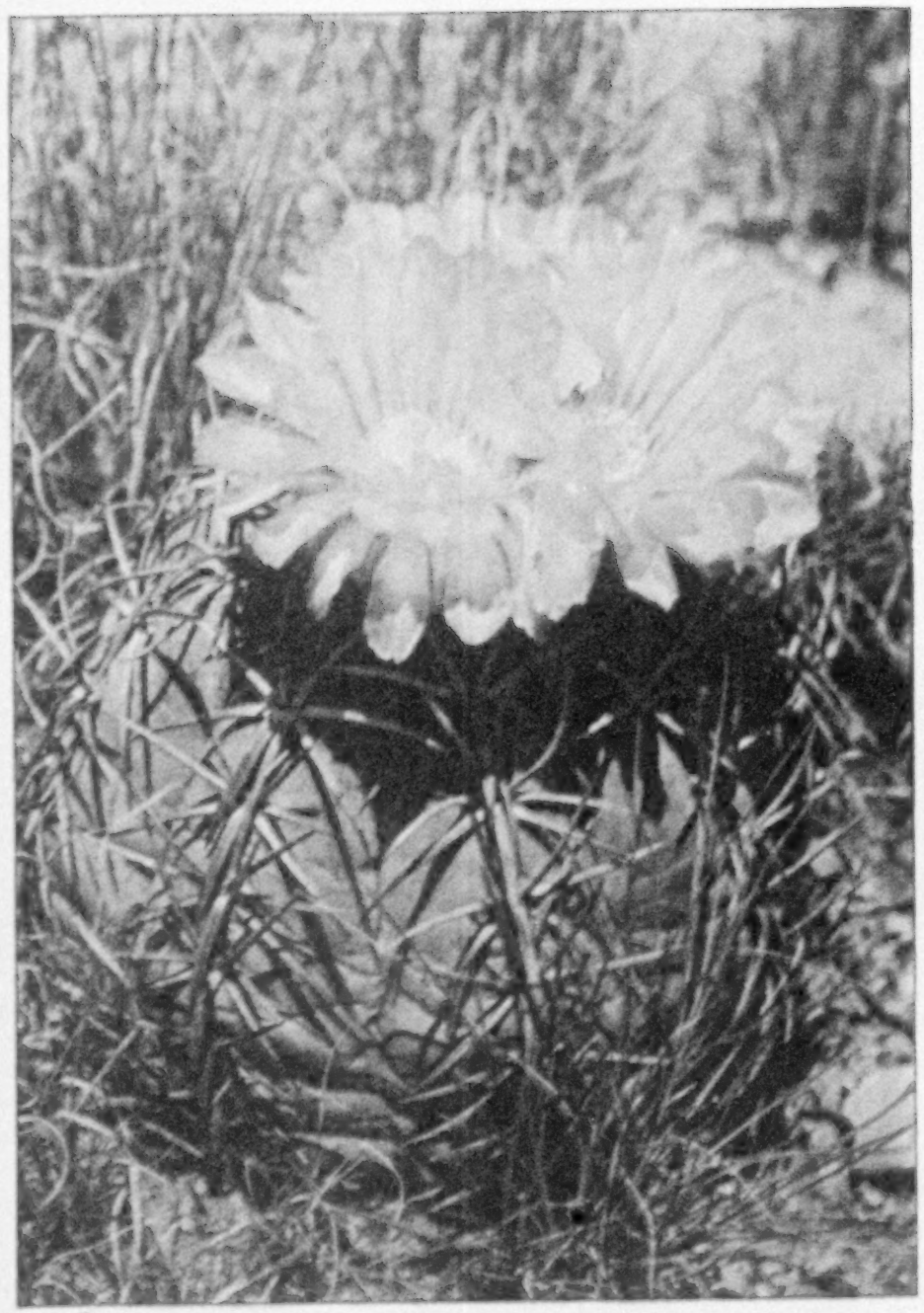
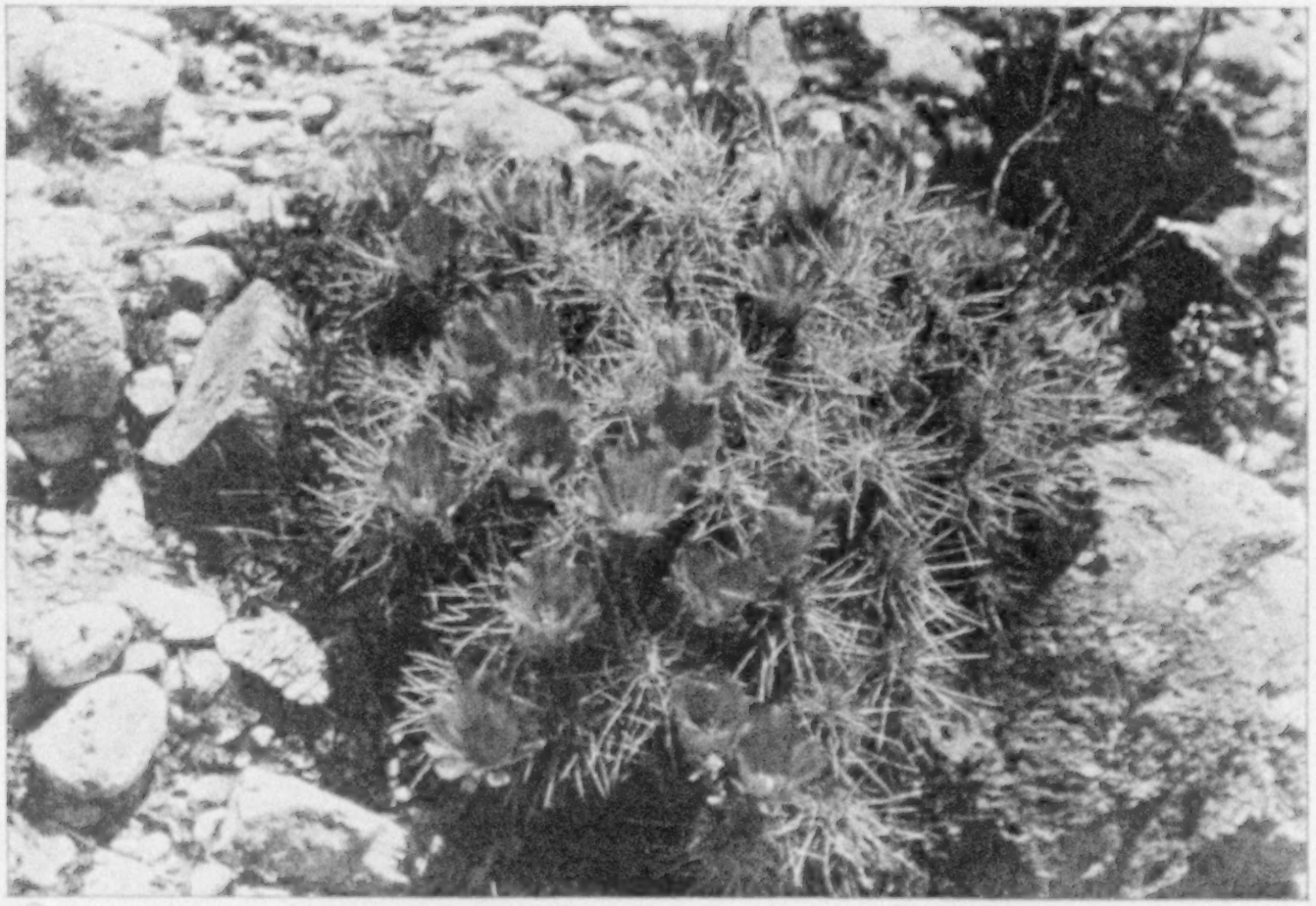
BEAUTY IN A WEARY LAND

This small, cylindrical, densely spiny cactus (*Coryphantha neomexicana*) adorns the sparsely covered rocky slopes of the foothills of the Guadalupe Mountains near Carlsbad Cavern, New Mexico. It is inconspicuous except in blossom time, when its brilliant flowers, massed thickly at the top of the somber-colored plant, vary the dull monotony of the brown landscape.



A MELON IN BLOOM

This small, grayish-green, globular cactus (*Echinocactus horizonthalonius*) is a familiar sight on the plains near the Guadalupe foothills. Its brilliant blooms are massed at the top, forming a crown of glory. The fruit, little less conspicuous than the flower, consists of large oblong berries which turn crimson or vermilion as they ripen.



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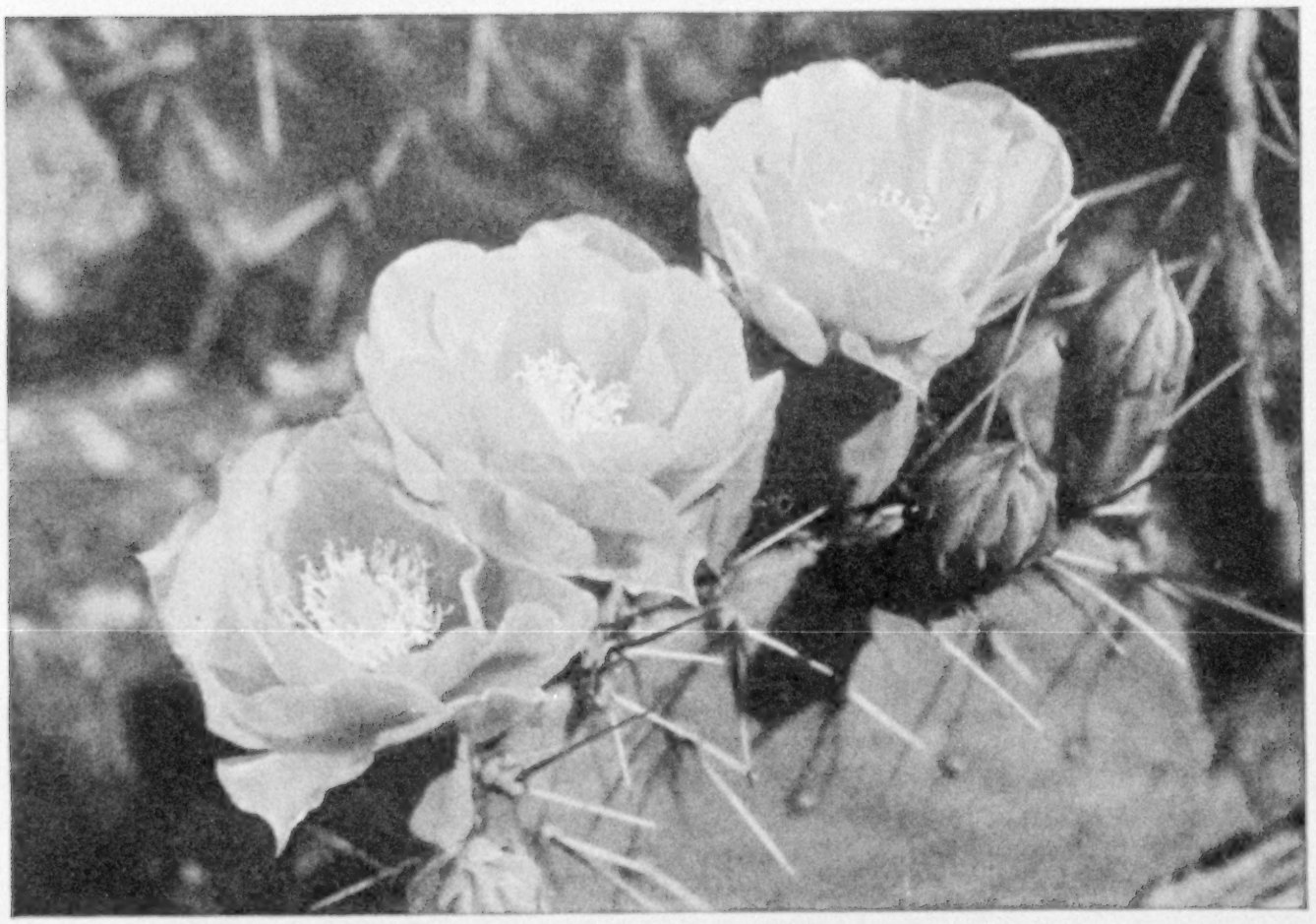
BANNERS OF THE DESERT

The strawberry cactus (*Echinocereus stramineus*), showing a small cluster of heads in the lower illustration and a nearer view above. The common name is suggested by the delicious brownish-red berries, crisp and juicy, which taste like strawberries. The green, spiny heads, hundreds in number in favorable places, are closely massed, forming great oval clusters three or four feet in diameter. The heads are covered thickly with long slender spines, and from the side spring the brilliant flowers. These plants thrive on limestone ledges and in blossom time they cause canyon walls to blaze with color. The blooms are sensitive to light; they reach the height of their glory in the morning sunlight, close toward evening, and "sleep" at night.



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THE ORCHID'S RIVALS

Above is a prickly pear (*Opuntia engelmannii*), which thrives in the sheltered nooks of the canyons of the Southwest. The plants, sometimes three or four feet high, grow in thickets. Many of the great fleshy pear-shape joints are solidly decorated along the edge with showy flowers, in the illustration reduced to about one-third the natural size. The fruit is conspicuous. When ripe the dark-red berries, two to four inches long, have crisp flesh of delicious flavor. The juice is used as a coloring fluid. The prickly pear below (*Opuntia tenuispina*) forms dense mats of spiny, interlacing branches which in early summer, after a shower, become flower beds of varied and delicate hue.

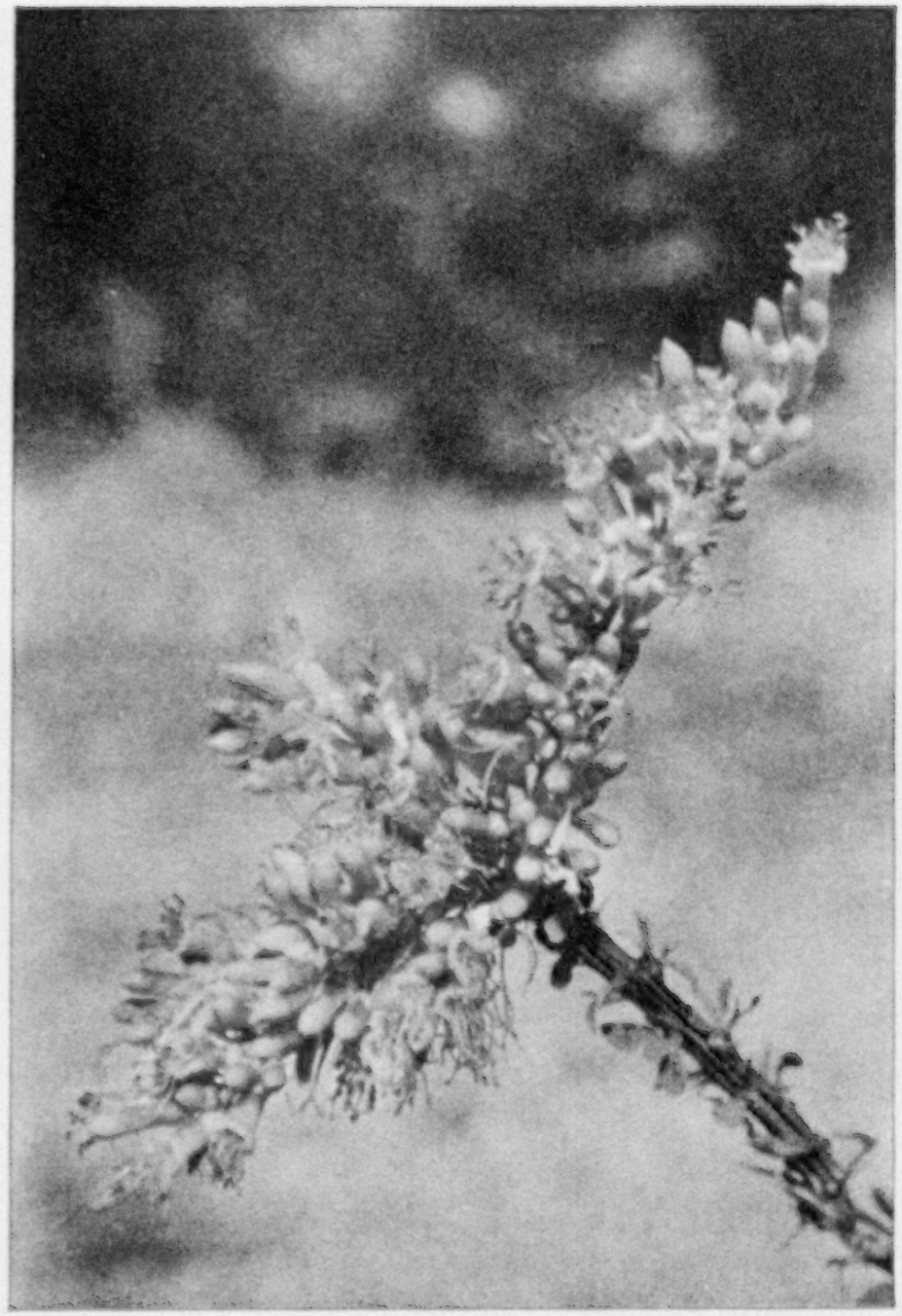
©

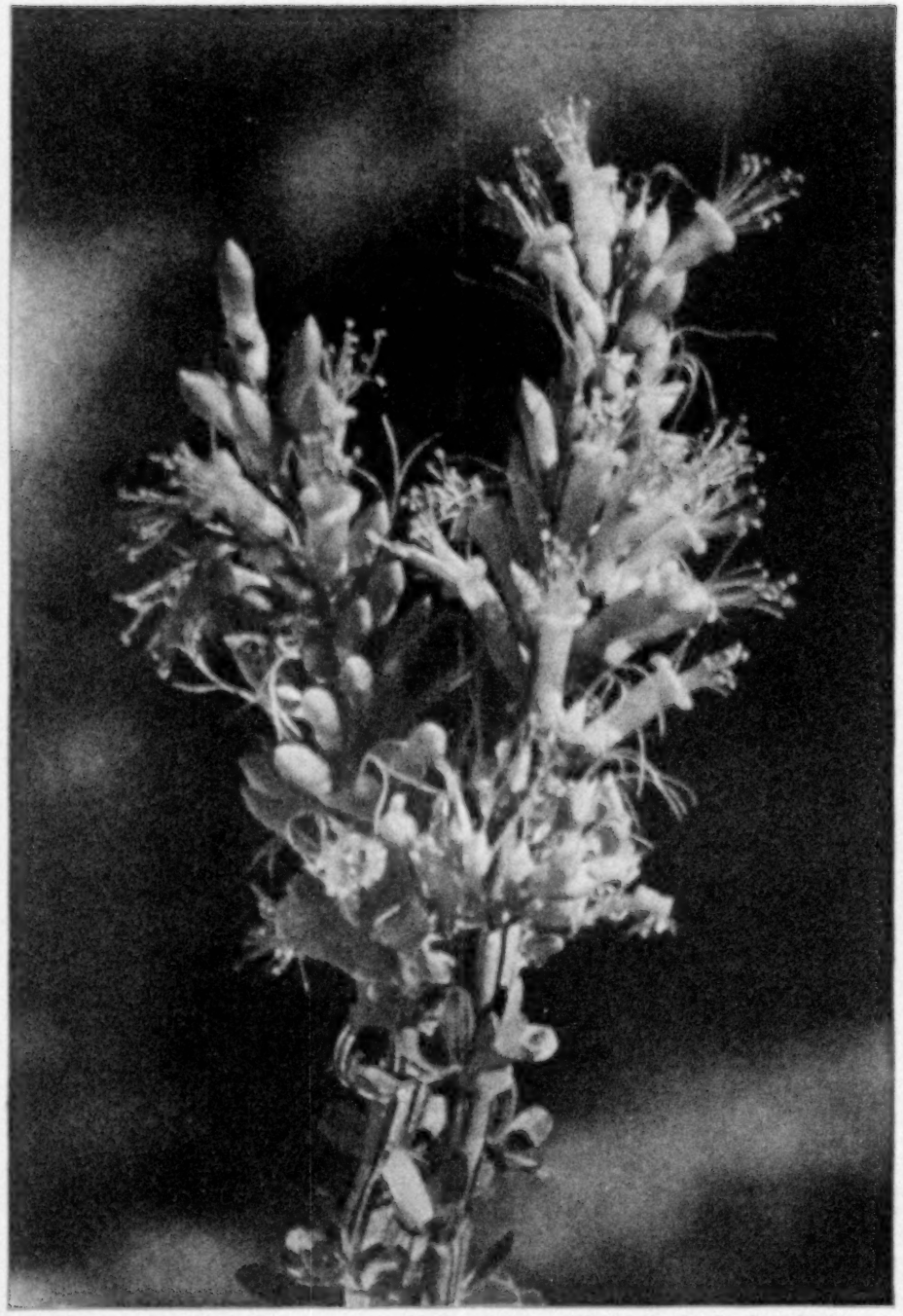
Natural Color Photograph by Jacob Gayer

IN A SOUTHWEST DESERT FLOWER GARDEN

The limestone hills near Carlsbad Cavern, New Mexico, are sparsely covered with green prickly pears, sotols, ocotillo or candlewood, and other species of desert plants. The ocotillos branch at the base into long furrowed, spiny stems. In early summer the tip of each stem bears a showy cluster of blossoms — the candle's flame (see Color Plates on opposite page). Later the green leaves appear and partly cover the ribbed, spiny poles.

XUM





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THE CANDLE'S FLAME

The showy top of an ocotillo stem (*Fouquieria splendens*) in full bloom is shown at the left, and a detail of the same plant at the right. The plant is also called candlewood, coach whip, and Jacob's staff.

"MIGHTY L'AK A ROSE"

An early-blooming strawberry cactus (*Echinocereus paucispinus*) with deep-green fleshy head, few ribs, and few spines. Unlike the strawberry cactus shown on Plate X, its blossoms, which appear early in the spring, remain open at night. When the fruit is fully ripe, its spines are readily brushed off, leaving a juicy, palatable berry.

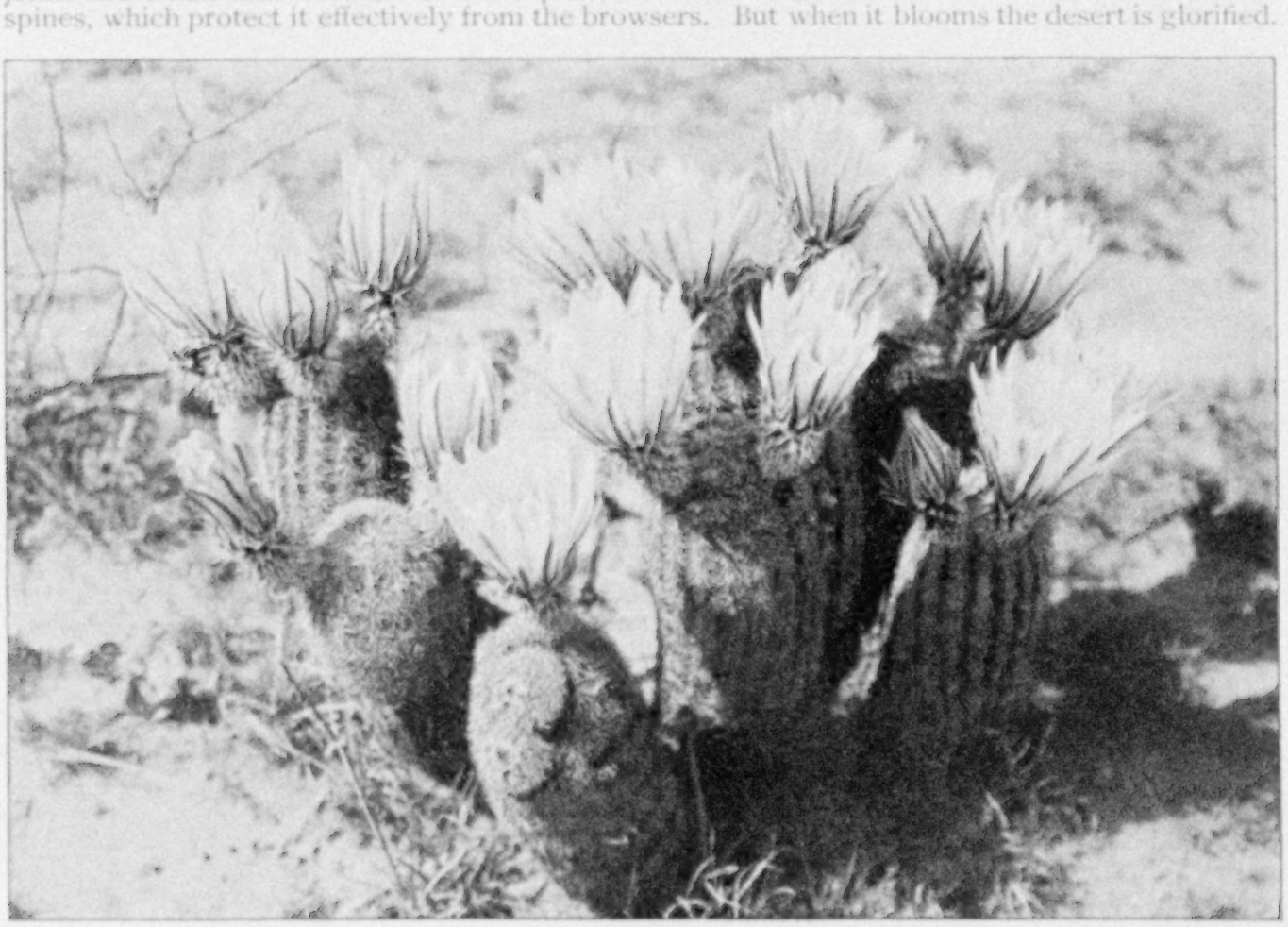
© Natural Color Photographs by Jacob Gayer

POSING UNDER DIFFICULTIES

This budding cowboy of stoical mien, lying beside a strawberry cactus, will have many an unpleasant encounter with cacti in years to come as he "punches" cattle over hill and plain.

A DESERT BEAUTY NEAR CARLSBAD CAVERN

This little prickly pear (*Opuntia pottsii*) consists chiefly of spines and gorgeous blooms. This specimen was found on the gypsum flat where desert conditions are at their worst. The joints are small and "lean," as if the plant were starved, and are covered with needlelike spines, which protect it effectively from the browsers. But when it blooms the desert is glorified.



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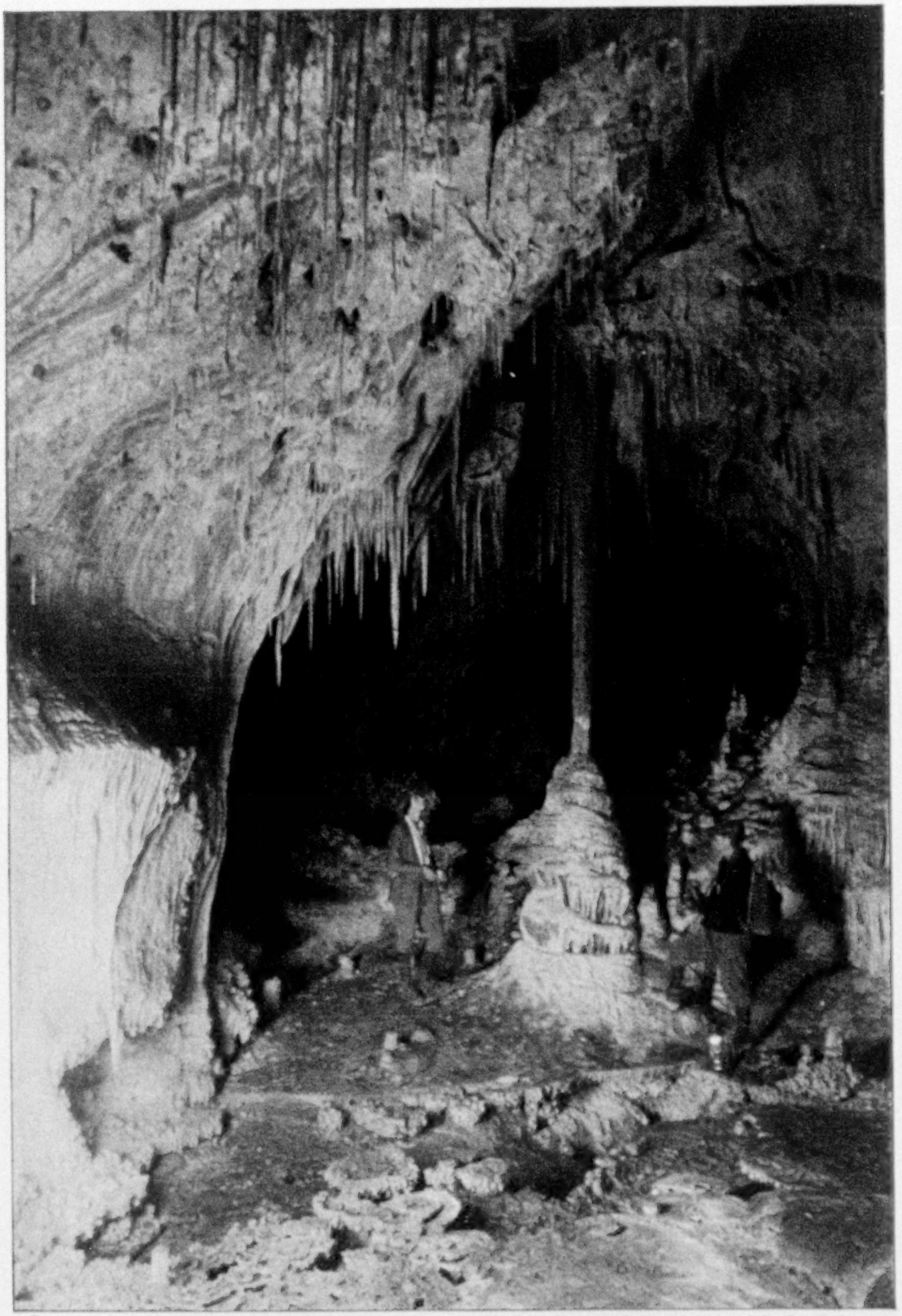
A RELATIVE OF THE RAINBOW CACTUS

This cactus (*Echinocereus dasyacanthus*) has many ribbed cylinders, about a foot high, which grow singly or in loose clusters, and are densely clothed with bunches of short spines.



© Natural Color Photograph by Jacob Gayer

THE DOME ROOM IN CARLSBAD CAVERN, NEW MEXICO

This chamber of weird beauty is decorated on all sides with delicately tinted crystalline onyx marble, known also as oriental alabaster. Oriental alabaster, composed of carbonate of lime, should not be confused with alabaster proper, which consists of sulphate of lime. The Cavern, which has been explored by two National Geographic Society Expeditions, has been set aside by Presidential Proclamation as a national monument.

from the grave pit (see page 297), we turned it on its side to permit the dust to sift out of the wrappings.

Amid the dust were two beautiful sets of turquoise, once elements of a mosaic. We searched for the ornament to which they belonged, but found no trace of it.

Months later, while I was preparing the mummy to be photographed for this article, another bit of turquoise was found beneath the chin, and across the breast my brush laid bare the deep impression of the rim of a basket which had been inverted over the head. Farther down, just below the end of the breastbone, there was a depression where a large oval pendant half an inch thick had settled into the flesh.

The story was now as clear as if set in good bold type. Centuries ago some aborigine had partially opened the grave, removed the basket which covered the face, reached beneath the wrappings, and withdrawn the coveted ornament. In so doing he loosened and lost the three turquoises, which remained to convince us that in ancient America, as well as in Egypt, grave robbers plied their trade.

If the Fates continue to be kind, some day they will guide my shovel to the bones of the one who in this case preceded me, for upon his breast the great pendant may still repose.

WOMAN'S MUTILATED MUMMY YIELDS RARE ORNAMENT

A few days' work in this cave so increased the bulk of our collection that two four-horse teams were necessary to freight it out of the reservation and over the 100-mile stretch between our camp and Gallup, New Mexico, the nearest railroad point (see map, page 232).

Throughout the ensuing months the lure of the canyon called imperatively, with the result that October, 1924, saw us again encamped among the sage and cacti.

At the close of a five weeks' campaign the freight teams once more trekked Gallupward laden with a precious cargo.

Many of the finds were fully as spectacular as those of the preceding season. In the grotto which had sheltered the looted burial an old woman had been interred back downward, with knees pointing vertically upward, as was the custom.

In the course of subsequent building activities a slab floor had been laid only four inches above the trunk. Necessarily the raised knees had offered an obstacle to its construction. In consequence the builders twisted off the legs and threw them down along the right side of the torso. Doubtless they also removed the baskets and other burial offerings which had been visible above the wrappings.

It was just before midday when I lifted the blanket-swathed trunk from its age-old resting place and laid it, with more disgust than reverence, upon a near-by ledge. Throughout the noon hour my thoughts were filled with sentiments more forceful than polite concerning the vandals who had deprived us of the spoils which I felt certain had been placed with the carefully wrapped remains.

Lunch over, as we waited for the blood to cease pounding in our ears after the climb from the valley floor to the cave, Owens, my helper for nearly a decade, said, "Let's see what is under that blanket."

I raised one edge of it and gave a shout that was occasioned not by pain or disappointment. Encircling the withered left wrist was a cuff five inches wide, composed of 200 perfectly matched *Olivella* shells with a single set of extraordinarily fine turquoise at the center. This time the laugh was on our side, for the robbers had overlooked an unusually handsome ornament and one unique among archeological material from the Southwest (see page 298).

"THE BURIAL OF THE HANDS"

In another portion of the cave we came upon "The Burial of the Hands." On a bed of grass, side by side, with palms uppermost, lay the ligament-bound hands and forearms of an adult. The severed elbows touched the wall of the cyst, thus proving that the burial as it was found was complete, and that the rest of the body had never been included in the interment.

Touching one radius were two pairs of unworn sandals with patterns in black and red, probably the most exquisite specimens of their kind that have survived for the inspection of modern man. Against

Photograph by Earl H. Morris

A MAZE OF ROCK PAINTINGS

The caves of the Canyon of Death are a veritable picture gallery. Upon the smooth rock faces are depicted tens of thousands of snakes, birds, men, and animals, as well as geometric patterns. Many pigments were used—white, yellow, blue, green, red, and black. In age the paintings vary from the red square-shouldered men drawn by the Basket Makers to charcoal drawings done by the present-day Navajo.

the other forearm was a small basket nearly half full of long, crescentic beads of white shell.

Heaped upon the wrists were three neck cords. One bore a single pendant of abalone shell as large as the palm of one's hand, and another two smaller ones of the same colorful, iridescent material. The third breast ornament was a masterpiece. Lashed at short intervals to the neck cord, and overlapping like links of armor, were 18 shell rings, each about three inches in diameter. As worn, they formed a tinkling white collar which reached from shoulder to shoulder.

Covering the entire cluster of treasures was a basket nearly two feet in diameter.

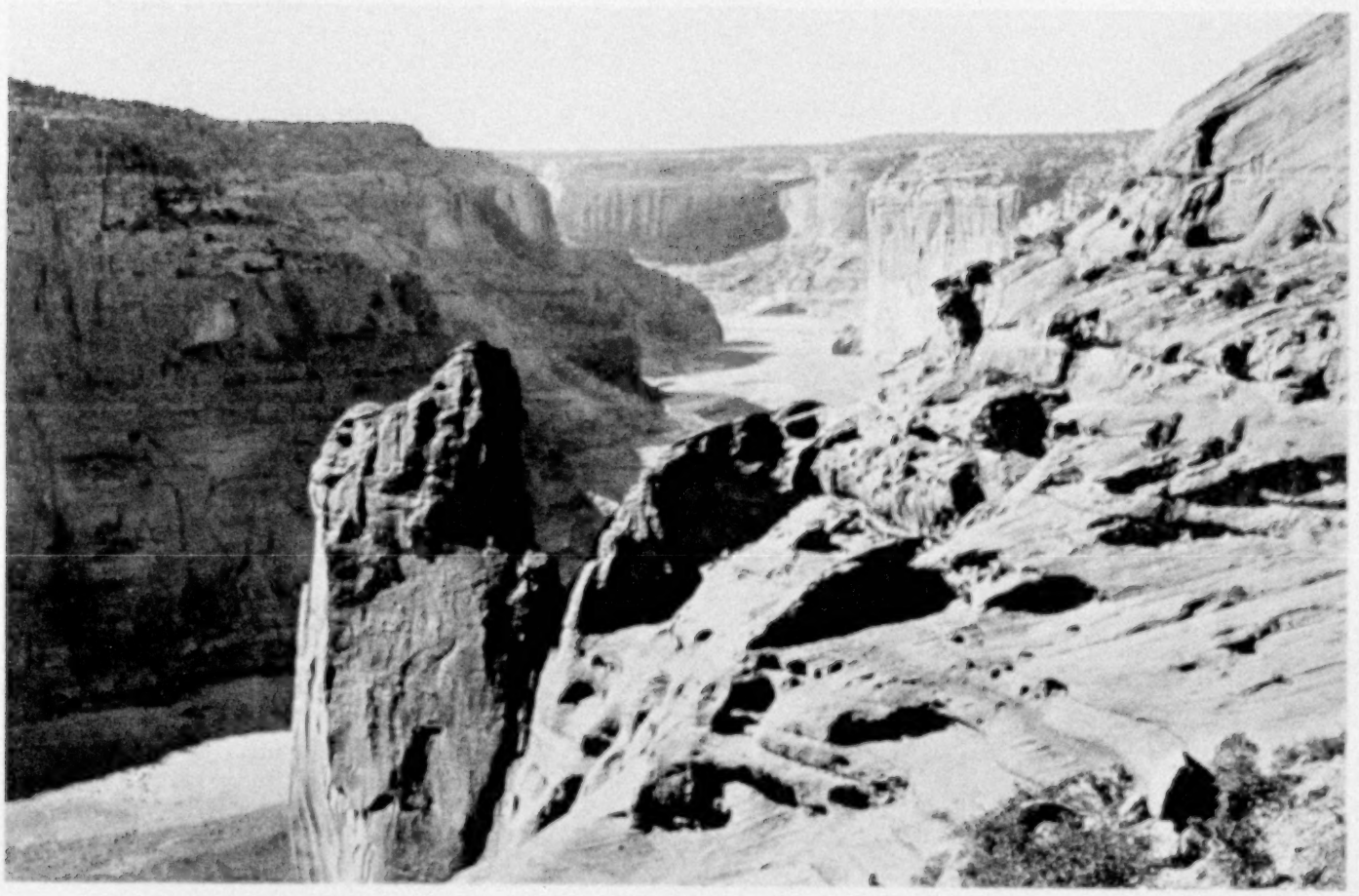
NOTES OF AN ANCIENT FLUTE CONJURE UP SCENE OF SAVAGE POMP

Several explanations of this "Burial of the Hands" could be written, but probably not one of them would come near to the truth of the mystery which lies behind it.

Our last great find was separated from the hands only by the thickness of an upright slab. Beneath a stone floor there lay nearly a wagonload of cedar bark and grass, crowded into a space six feet by three. The surface of it was bright and fresh, as if it had been deposited but yesterday. However, at a depth of a few inches it changed to a mass thoroughly carbonized, but not reduced to ash.

Since the charring did not extend to the outer limit of the inflammable material in any direction, the fire could not have been set after the burial was completed. Spontaneous combustion seems out of the question; hence it appears not improbable that fire was buried with the dead.

As my fingers reached the offerings with the first body, I cursed the destructive agencies—decay, erosion, burrowing animals, vandals, fire—which so often had conspired to thwart us. A large basket had lain over the head, and on the breast were beads of wood and of yucca seeds, a stone pipe, and many other objects



Photograph by Earl H. Morris

A VIEW DOWN CAÑON DEL MUERTO FROM PICTOGRAPH CAVE

On an autumn afternoon black shadows creep across the valley floor, the streamlet lies like a silver ribbon flowing in the trail of a snake, green cactus patches alternate with yellow fields of corn, the northern cliffs tower flaming red beneath their crown of black-green forest, and the rocks in the foreground, full struck by the waning sun, blaze with ruddy gold.

charred beyond recognition—a taunting mass of ruin.

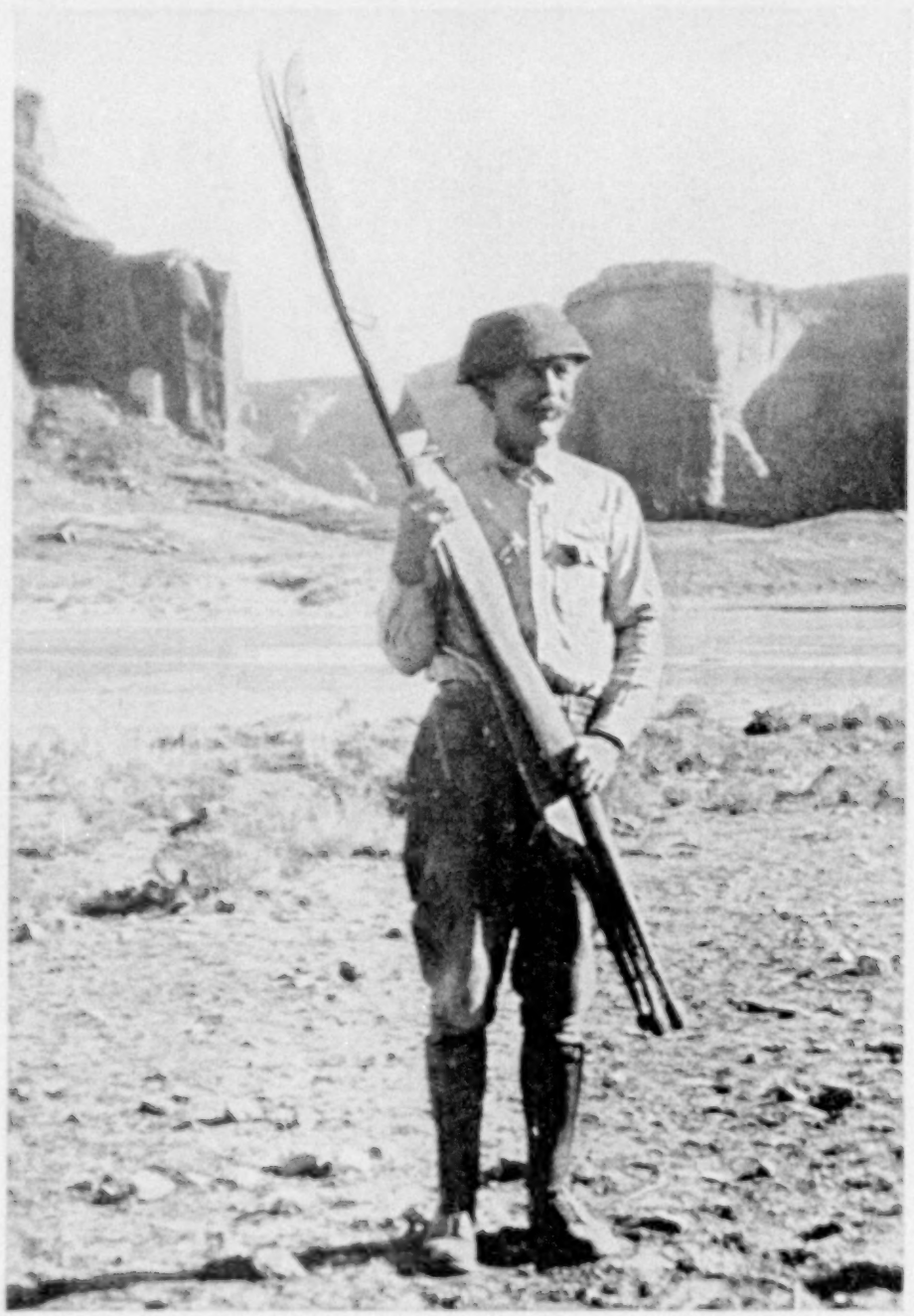
But again the frown of Fortune ended in a smile. The blackened knees of another body were beside the skull of the first. As we worked downward along the thighs, the burned area became smaller and smaller, and finally ended where the fire had smothered out, just as it reached the trunk.

The body was that of an old man, surely once a priest or chief. Beside the usual offerings of beads, baskets, and sandals, there lay above his buckskin wrappings a flute, one end beneath the chin, the other between the thighs. By the left shoulder was a basket containing an enormous stone pipe and many thick hanks of human hair, each wrapped and tied at the center with a cord.

Along the left side was a mass of wooden objects, all readily perishable, hence extremely rare in perfect condition. Conspicuous among them were bone-tipped flint flakers with which knives and projectile points were made, several spears, four handsomely wrought spear throwers, and three more flutes.

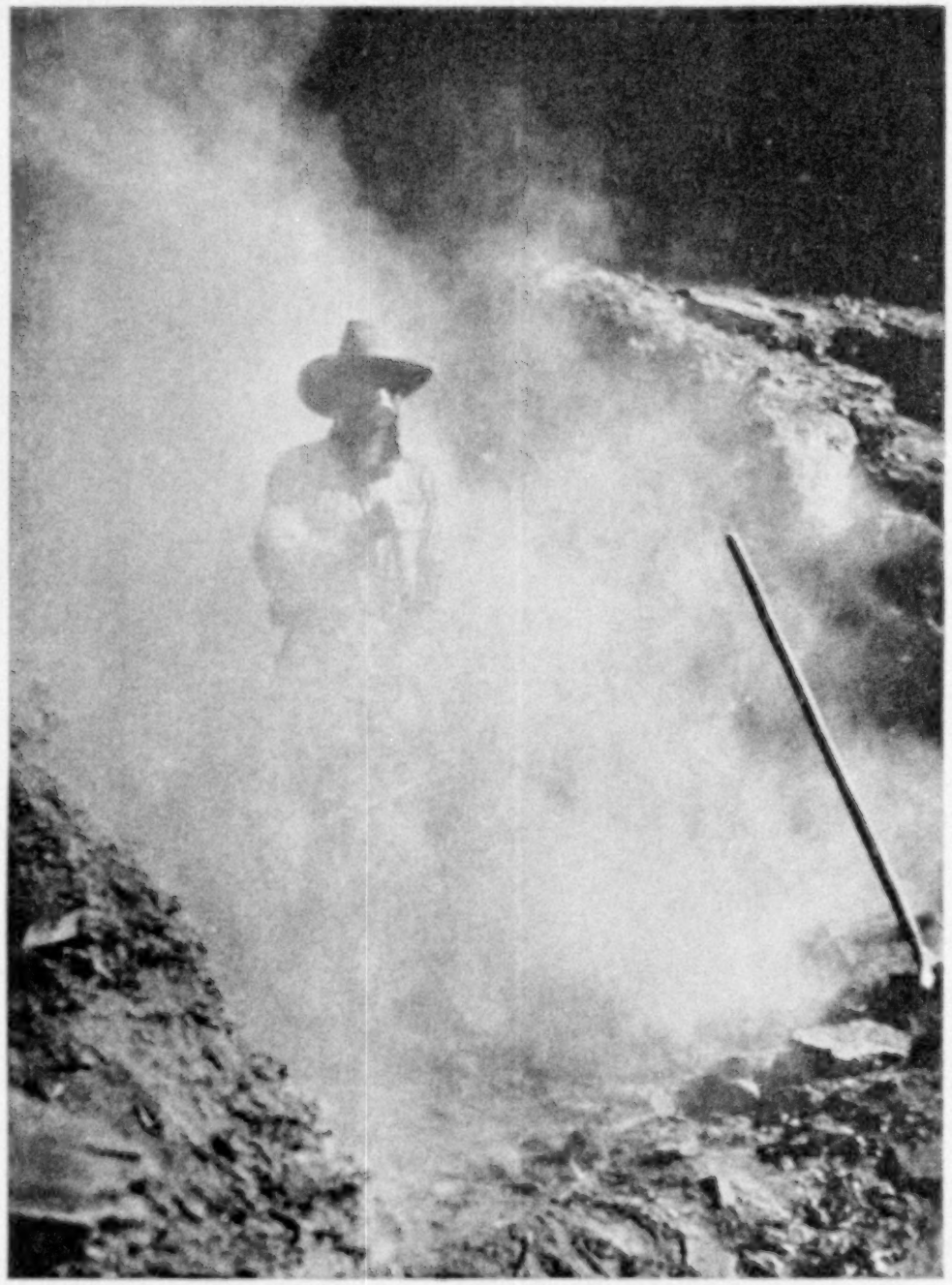
I picked up one of the flutes, shook the dust and mouse dung out of it, and placed it to my lips. The rich, quavering tones which rewarded even my unskilled touch seemed to electrify the atmosphere. In the distance Navajo workmen paused with shovels poised, seeking the source of the sound. A horse raised its head and neighed from an adjacent hillside and two crows flapped out from a crevice overhead.

Our little group was motionless for a dozen heartbeats, which seemed as many minutes. In the weird silence it was as if time had been halted in its flight—nay, turned back—for in swift array there crowded through my consciousness the scenes of grief and mourning, of savage pomp and ceremonial, amid which the tones of that instrument had last echoed from the selfsame cliff that now glistened under the rays of the setting sun, which



POSING WITH HIS TROPHIES

In jovial mood, Owens, whom the author describes as "the best digger in all the Southwest," dons as a hat a basket which for a few centuries lay over the head of a mummy, and holds before him a sheaf of three huge oaken blades which he found beneath a cliff-house floor.



AN EXCAVATOR WEARING A GAS MASK IN MUMMY CAVE

A gray pall always hangs above the pits where the workmen search for treasures of the past. The fine dust, blended of ash and filth and human waste, will exact its toll if not excluded from the lungs. Hence one labors for breath behind a mask of wet cloth or sponges.

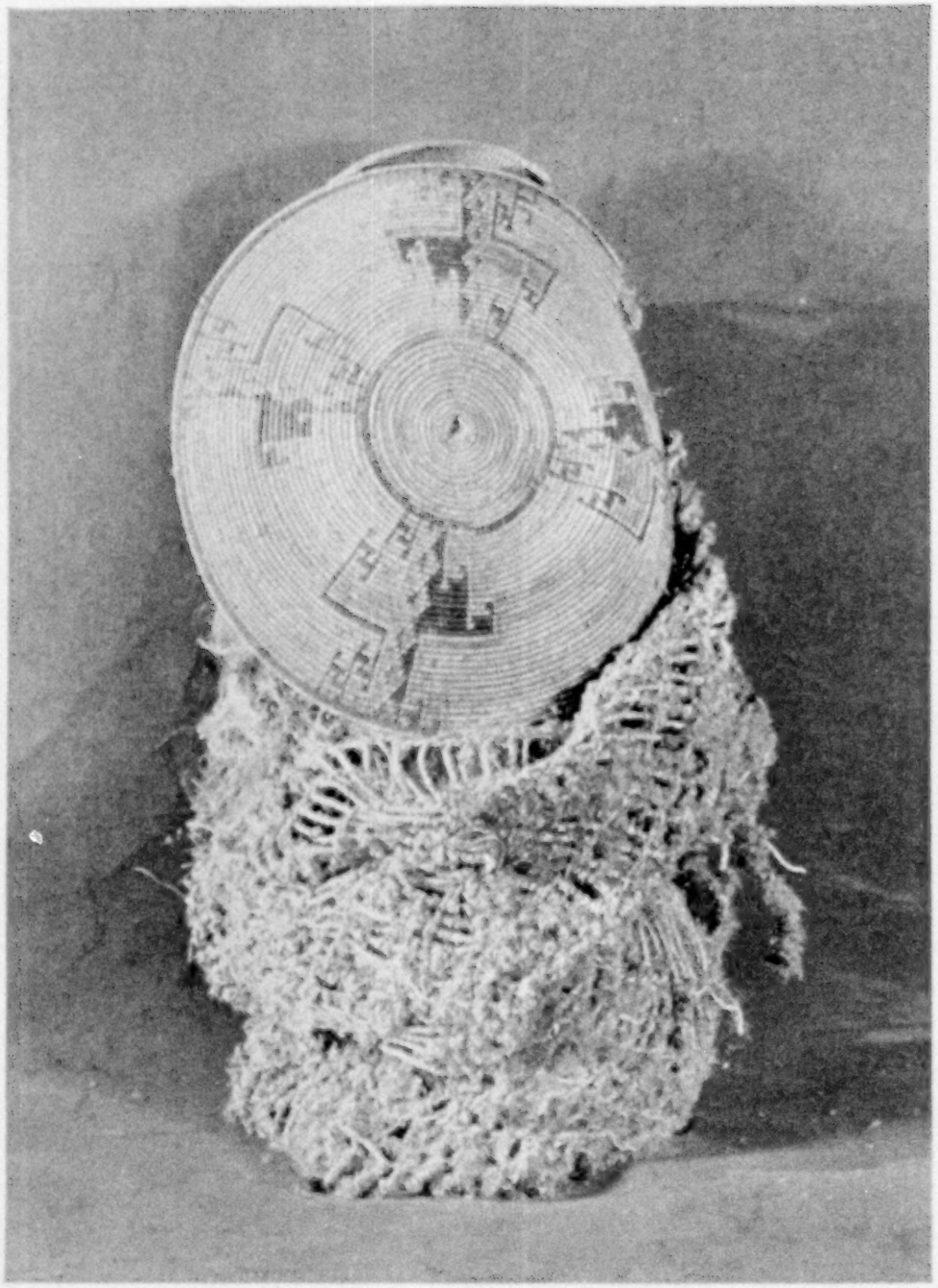
Photographs by Earl H. Morris

XUM

Photograph by Earl H. Morris

A BASKET MAKER OF LONG AGO: CAÑON DEL MUERTO

His grave was a bark-lined crevice between the foot of the cliff and a natural block. Unmindful of his presence, later occupants of the cave raised the floor full five feet by the gradual deposition of refuse and building waste. The Basket Makers probably came to Arizona from Mexico long before the time of the Pueblo culture, which had passed its zenith in 1540, at the time of the visit of the *conquistadores*.



Photograph courtesy American Museum of Natural History

THE BURIAL BUNDLE OF AN AGED WOMAN

In preparation for interment, the body was flexed so that it occupied the least possible space, padded with fiber of the yucca plant, and laid across a feather-string blanket. Two bowl-shaped baskets, one within the other, were placed beneath the head and a very large one inverted over it; then the blanket was folded over to inclose them. A corner of the blanket has been turned back to reveal the magnificent basket.

© Roland W. Reed

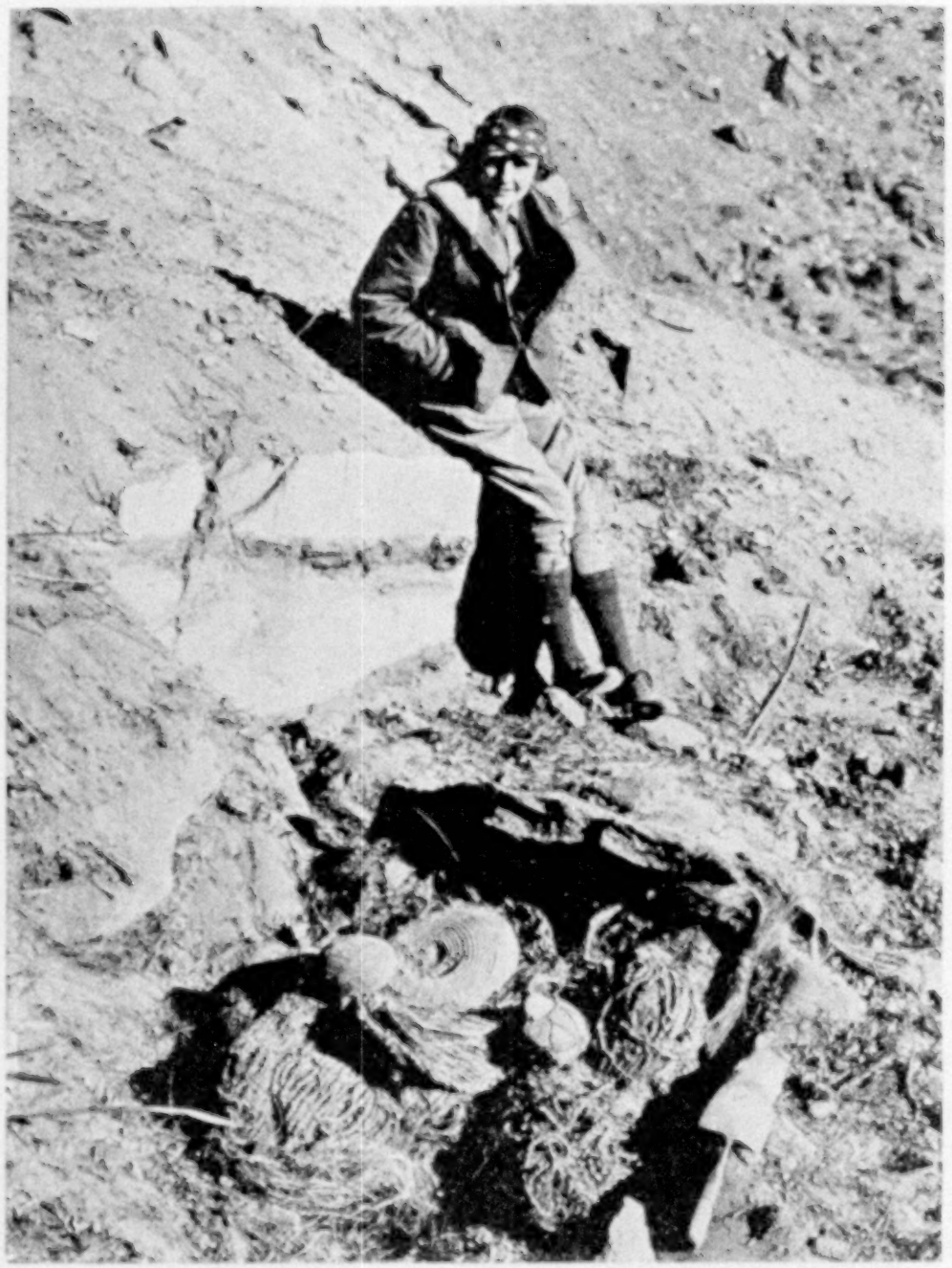
THE POTTERY MAKER

The Indian Pottery Makers were products of a higher civilization than the Basket Makers. The former achieved the greatest development of their art in pre-Columbian America at Pueblo Bonito (see text, page 239). This worker is one of the Hopi Indians, who have inherited some of the skill of the ancient pueblo dwellers.

Photograph courtesy American Museum of Natural History

A MUMMY FROM THE LOOTED BURIAL, HIS WRAPPINGS LAID ASIDE

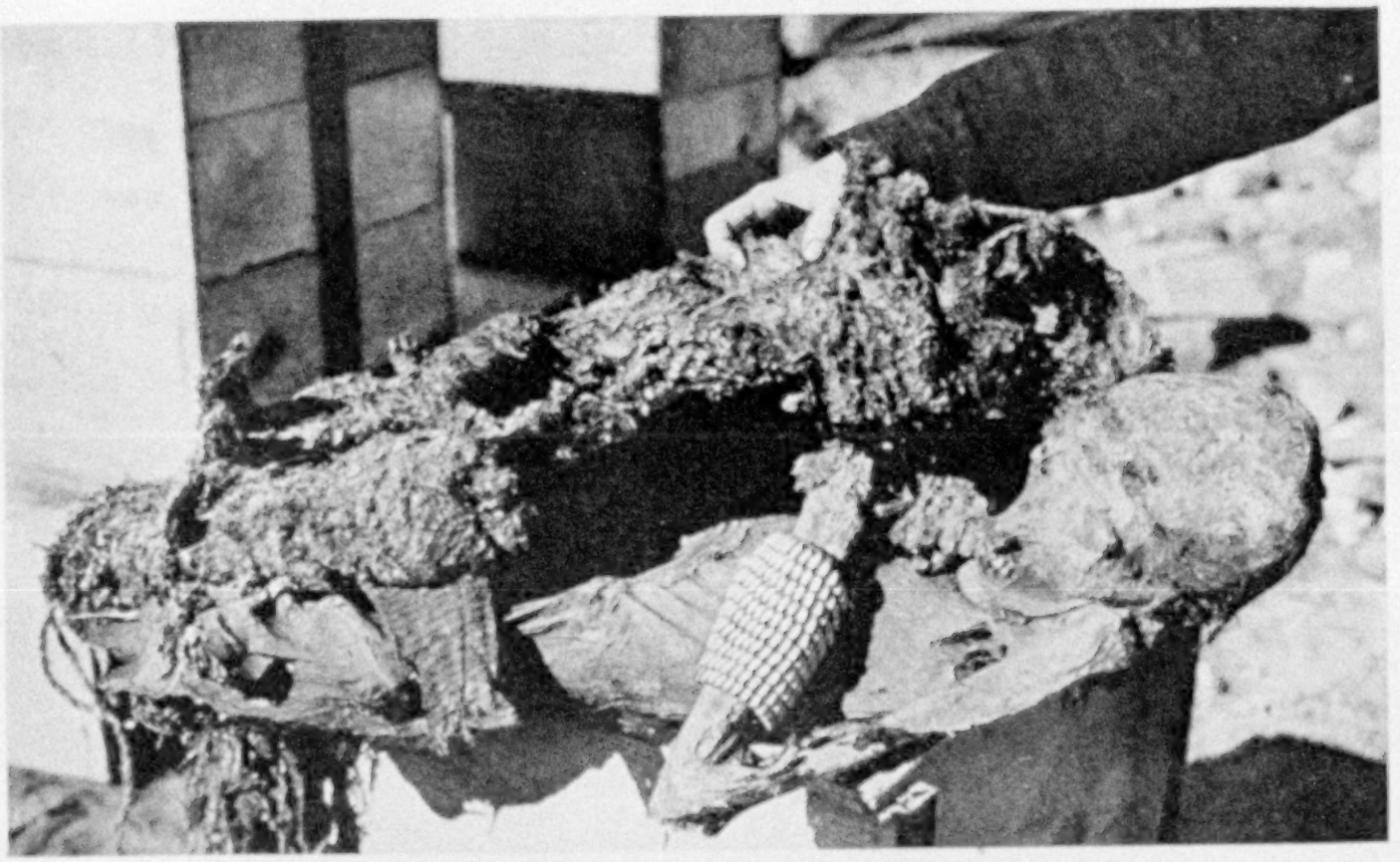
The impression of the large, oval, turquoise mosaic which had been removed in pre-Columbian times may be seen just above the left wrist (see text, page 291). The mark of the basket which once covered the head is also visible across the breast. These "mummies" are merely desiccated bodies, since embalming was not practiced by any native American people.



Photograph by Earl H. Morris

AT THE BRINK OF THE SLOPE IN FRONT OF THE GREAT CAVE: CAÑON DEL MUERTO

It was Mrs. Morris who freed the specimens of the dust of ages and of the filth left upon them by a far from cleanly people. Desirous of seeing the patterns which washing would bring out upon the baskets, she waited eagerly while the photographer made the exposures necessary before the contents of the grave could be removed.



A RARE ARMLET WOVEN OF CORD AND SHELLS

Usually the aboriginal grave robbers were disappointingly thorough, but occasionally there was a slip in their technique. They twisted off the legs from the body of this old woman and removed the baskets which were about the head, but they failed to raise the feather blanket which concealed an ornament unlike anything previously unearthed in the Southwest (see p. 291).

Photographs by Earl H. Morris

THE GRAVE OF A CLIFF-DWELLER BABY

The body was swathed in a feather-string blanket and lay on a mat of plaited rushes. By the head were single fragments from each of two pottery bowls, and beside the chin was a little jar filled with squash seeds. Upon the breast was a rattle made of five walnut shells strung on a cord. The baby's cradle, made of cottonwood bark, had been broken and the fragments placed as a covering for trunk and limbs.

Photograph by Earl H. Morris

PACKING DAY IN CAMP

During the bothersome task of adjusting mummies, pots, and baskets inside a limited number of crates, Mrs. Morris, Tatman, and Owens were almost envious of the mummies seated in the foreground.

for a brief moment had broken through the dark clouds masking the November sky.

DUST A MENACE TO LIFE

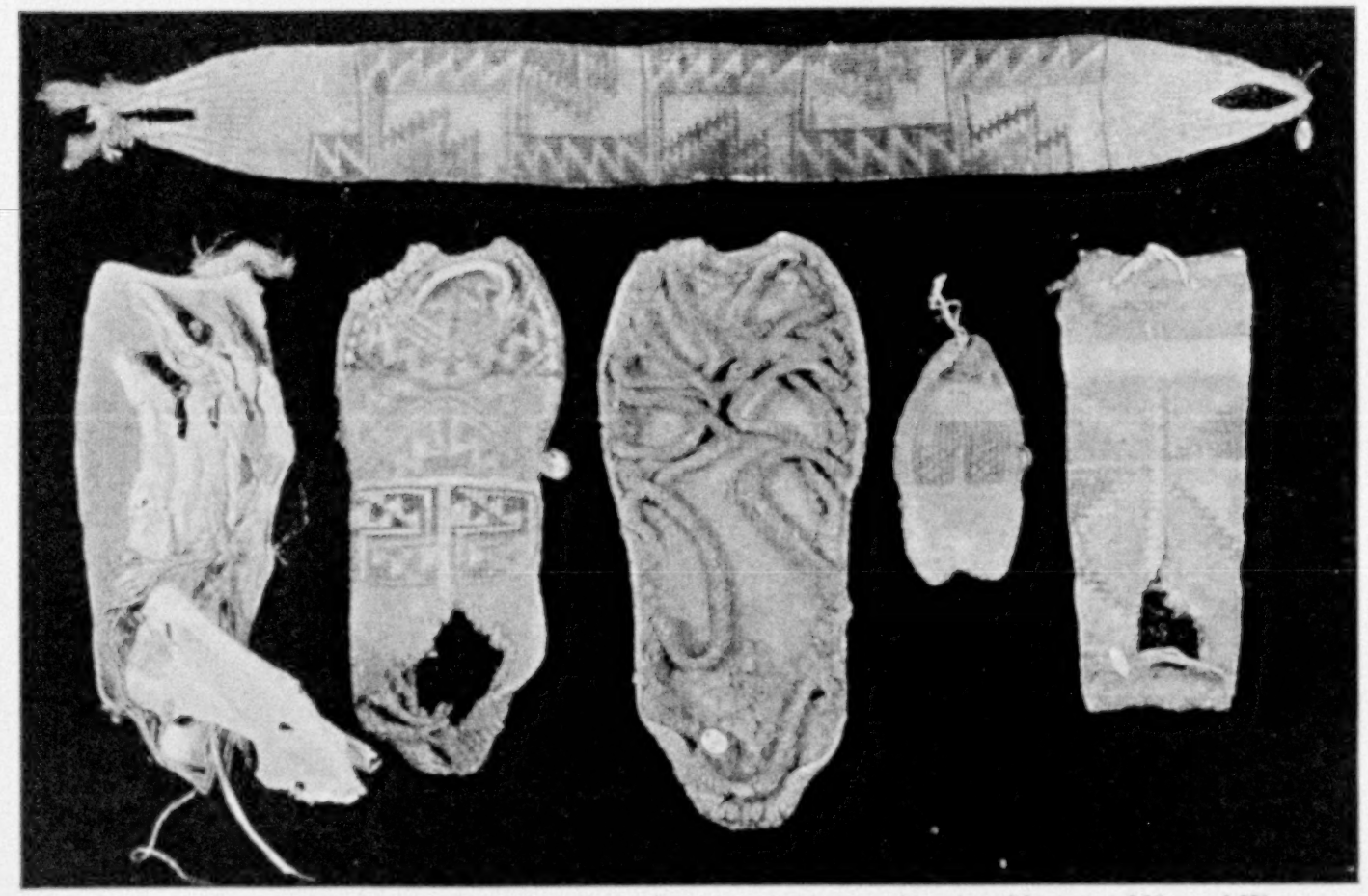
The preceding paragraphs record merely the most striking events during our explorations in Cañon del Muerto. Nothing has been said of days of tedium; of barren trenching, of measuring, of photographing; nor of the dust, which is a menace both to life and comfort. The least disturbance of the earth in these caves, where there has not been a drop of moisture for millenniums, stirs up a gray cloud so dense that sometimes one cannot discern even the outline of an assistant a shovel's length away (see page 294).

To work in such places, one must breathe through several thicknesses of moist cloth or face the consequence, which is a violent chill with a tendency to develop into pneumonia.

Nor have I mentioned the months of careful study which will be necessary before the thousands of specimens will have told the last detail of their story. That story will reveal the cultural history of the aborigines of the Southwest previous to the arrival of the Spanish conquerors. Already the chapter heads have been translated and a brief of the pages written, but it will be many a year before the last paragraph is filled in.

Probably the exact date of the first human inhabitation of the Southwest will never be known, but by a conservative estimate it was all of 4,000 years ago. The first settlers of whom a trace has been discovered were an extremely long-headed people of medium stature. They were undergoing transition from nomadic to sedentary existence under the compelling influence of the cultivation of maize. This cereal, together with the few wild fruits and seeds which the barren environment afforded, augmented, of course, by the none too plentiful game supply, provided them with food.

Although their tools were of few types, and made exclusively of stone, bone, and wood, they were skilled artisans in several lines. They were past masters in weaving



Photograph courtesy American Museum of Natural History

MASTERPIECES OF PREHISTORIC TEXTILE ART

Aside from fur- or feather-string blankets, and narrow aprons in the case of the women, sandals were the only clothing ordinarily worn by the early inhabitants of the caves. Upon their footgear and upon their burden straps they lavished the utmost care, decorating them in colors, and in raised patterns produced by baffling, intricate manipulations of the weft threads.

and basket-making, and no Southwestern people has surpassed them as workers in wood. However, they had not learned to use the bow and arrow; to make pottery or to build walls of masonry.

These so-called Basket Makers, who probably emigrated from some part of the territory that is now Mexico, occupied the Southwest unmolested for a considerable length of time. Eventually, however, there came among them a roundheaded stock, bringing with it new manners, customs, and arts. From a blending of the two, there resulted the beginnings of the Pueblo culture, which, although it had passed its zenith before 1540, still survives.

The simple culture of the Basket Makers marks the beginning, and the creditable civilization which flourished in Pueblo Bonito, made familiar to the scientific world through the explorations of the National Geographic Society under the direction of Mr. Neil M. Judd, marks the culmination of aboriginal advancement in the Southwest (see pages 227 to 262).

The three or more cultural periods which intervened need be only mentioned. The caves of northeastern Arizona were occupied during the entire range of the inhabitation of the region by sedentary agricultural peoples, and after the latter had departed, after even Pueblo Bonito had been given over to prairie dogs and owls and drifting sand, the Navajo arrived and found Cañon del Muerto a congenial dwelling place. To-day, in riding through it, one passes an occasional stunted peach orchard, a cornfield, a melon patch, or a squalid hut, and if one remains long enough, one becomes acquainted with the 40 or 50 Indians who now inhabit it.

They are a dwindling remnant. Within a few generations their blood will be extinct, or else their life and customs will have become so changed, as a result of contact with our own civilization, that they will no longer be real Navajo.

Thus, as far as aboriginal peoples are concerned, this gorge is truly a canyon of death, and the Spanish raiders struck deeper than they knew when they named it Cañon del Muerto.

NEW DISCOVERIES IN CARLSBAD CAVERN

Vast Subterranean Chambers with Spectacular Decorations Are Explored, Surveyed, and Photographed

By Willis T. Lee

Leader of the National Geographic Society's Exploration of Carlsbad Cavern, New Mexico

CARLSBAD CAVERN, New Mexico, is the most spectacular of underground wonders in America. For spacious chambers, for variety and beauty of multitudinous natural decorations, and for general scenic quality, it is king of its kind.

Long known locally, this underground marvel was first disclosed to the readers of the National Geographic Magazine in January, 1924.* Following this publication, the National Geographic Society sent an expedition to explore further the cavern and the mountains near it.

The results of the explorations have proved that the early estimates of size were not excessive, and that the statements relating to the unusual nature of the cavern were in no sense exaggerations.

The cavern, which has been set aside as a national monument by President Coolidge, is situated in southeastern New Mexico, 26 miles southwest of the town of Carlsbad. It is the best known of many caves in a region of unusual beauty in the Guadalupe Mountains, a range which rises abruptly from the desert plain to altitudes of more than 9,000 feet (see map, page 232).

Among those who visited the National Geographic Society's camp at the cavern during our six-months' work were the governors of New Mexico and Texas, the Director of National Parks, and many other officials of both national and State organizations.

CAMP LIFE AT CARLSBAD CAVERN

One of the results of The Society's activity in holding up to the inspection of the world the glories of Carlsbad Cavern has been the creation of a State park in Texas, at the southern end of the high part of Guadalupe range (see illustrations, pages 316 and 317).

Our camp was established at the mouth of the cavern, in the rough board shacks used by a fertilizer company years ago, when guano was being taken from the cave.† Water was carried by burro from the nearest spring, nearly a mile away, and wood was "rustled" from the mountain side, where a few stunted shrubs are found.

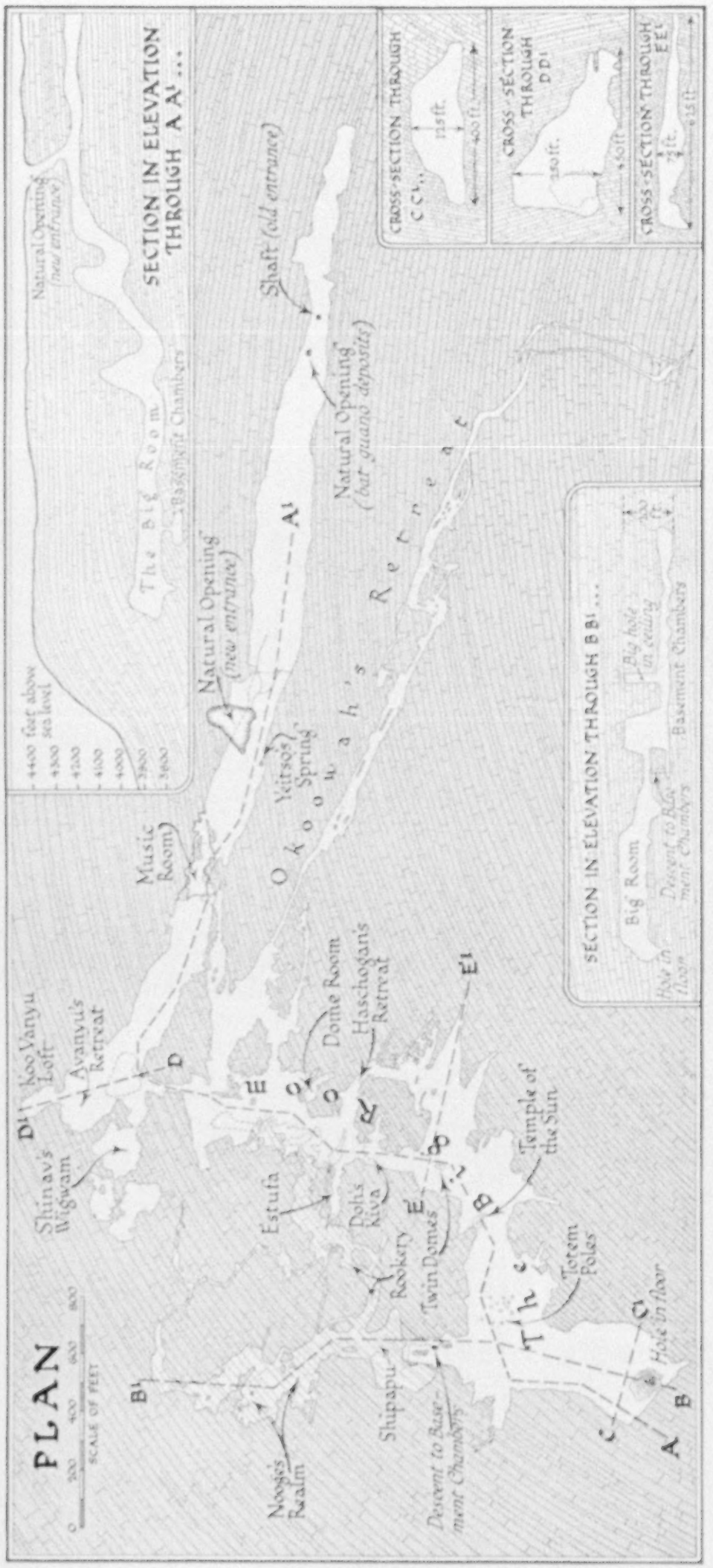
Supplies were carted from Carlsbad, 26 miles away. The first load was brought by a native team consisting of 4 mules, 4 burros, and 1 horse; it took the combined efforts of the 9 animals and 16 men to get a ton of provisions up the mountain side. After this experience supplies were brought by motor truck.

There was no refrigerator in camp, and there were no shade trees. Most of the time there were no clouds in the sky, and, while the nights were always cool, during the day the sun beat upon us mercilessly, the temperature hovering between 100° and 115° F. in the shade—and no shade to be found. There was, however, always the cool cavern, into which we could descend, where the temperature is uniformly about 56° F., and the small opening at the side of the elevator shaft served in place of a refrigerator. Perishable provisions were lowered 50 to 75 feet into this opening, where they remained cool and fresh.

The darkness of the cavern, its unbroken silence, and its unearthly aspect affected the workers in different ways. Some feared the dark and frankly confessed it; others feared and were ashamed of their weakness. Some were attracted by the mysteries of the unknown and were ever peering into dark corners; others clung tenaciously to the beaten path and were persuaded with difficulty

*See "A Visit to Carlsbad Cavern," by Willis T. Lee, in the National Geographic Magazine for January, 1924.

† See "Bats of the Carlsbad Cavern," by Vernon Bailey, page 321.



A SKETCH MAP OF CARLSBAD CAVERN, WITH DIAGRAMMATIC CROSS-SECTIONS

Drawn by Charles E. Riddiford from surveys by Willis T. Lee

to leave it. It was obvious that all who worked regularly in the cavern were under a mental strain.

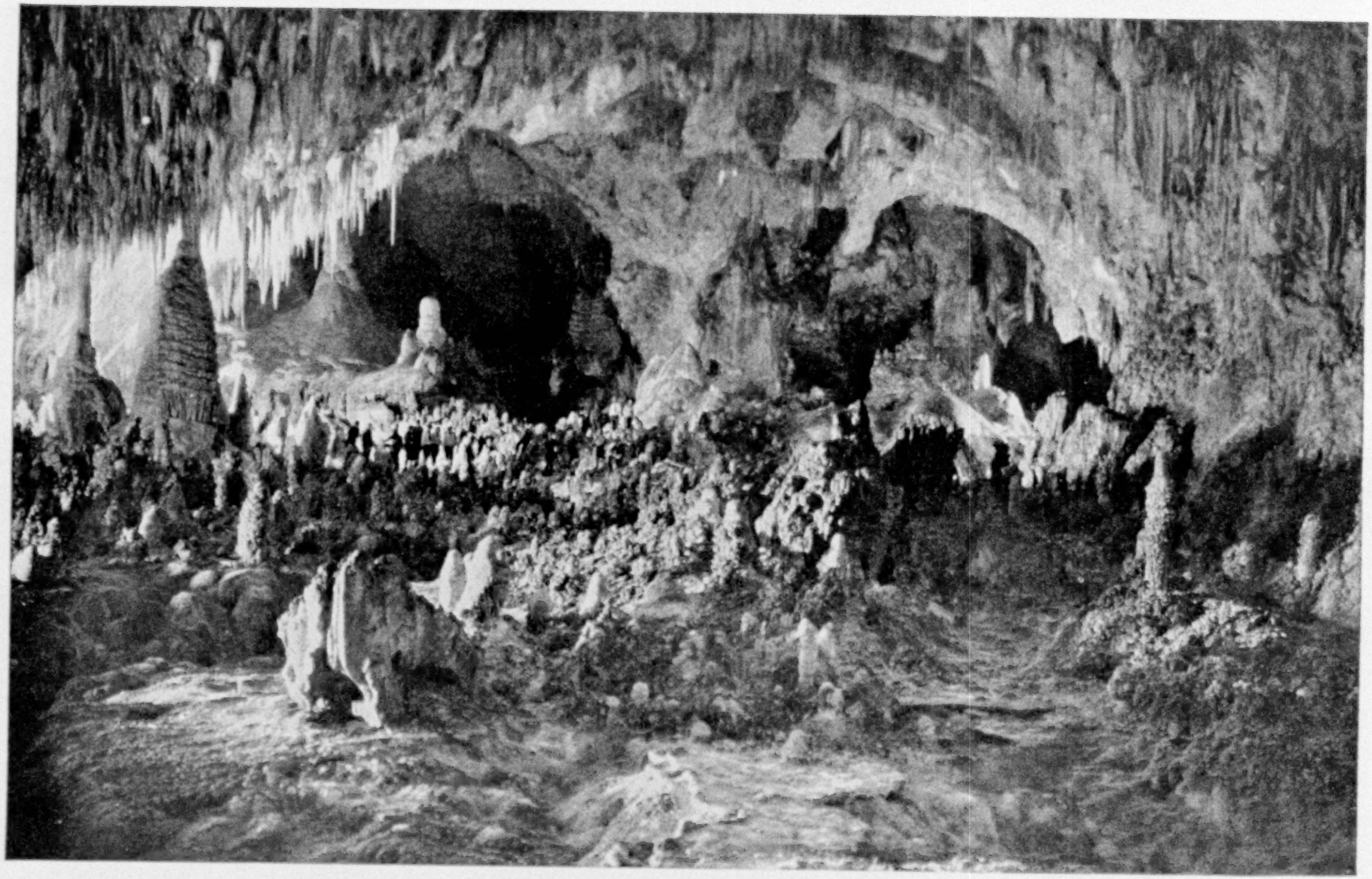
LANTERNS PROVIDE THE ONLY ILLUMINATION

Exploration began about the middle of March and was carried on under circumstances quite out of the ordinary. New methods had to be devised for the simplest operations.

A supply of gasoline was needed in the cavern to refill lanterns. The surveyor filled a canteen, swung it over his shoulder, and started. The can leaked. He noticed a slight dampness in the clothing on his back, but gave it little attention until his flesh began to smart. Even then, not realizing that a gasoline blister may be serious, he continued to work for several hours. With the help of a doctor, he spent the next ten days in growing new skin.

The first work was to improve the trail, which was traveled each day to the more spectacular parts of the cavern, where most of the work was done. This extends for nearly three-quarters of a mile through a great subterranean vault

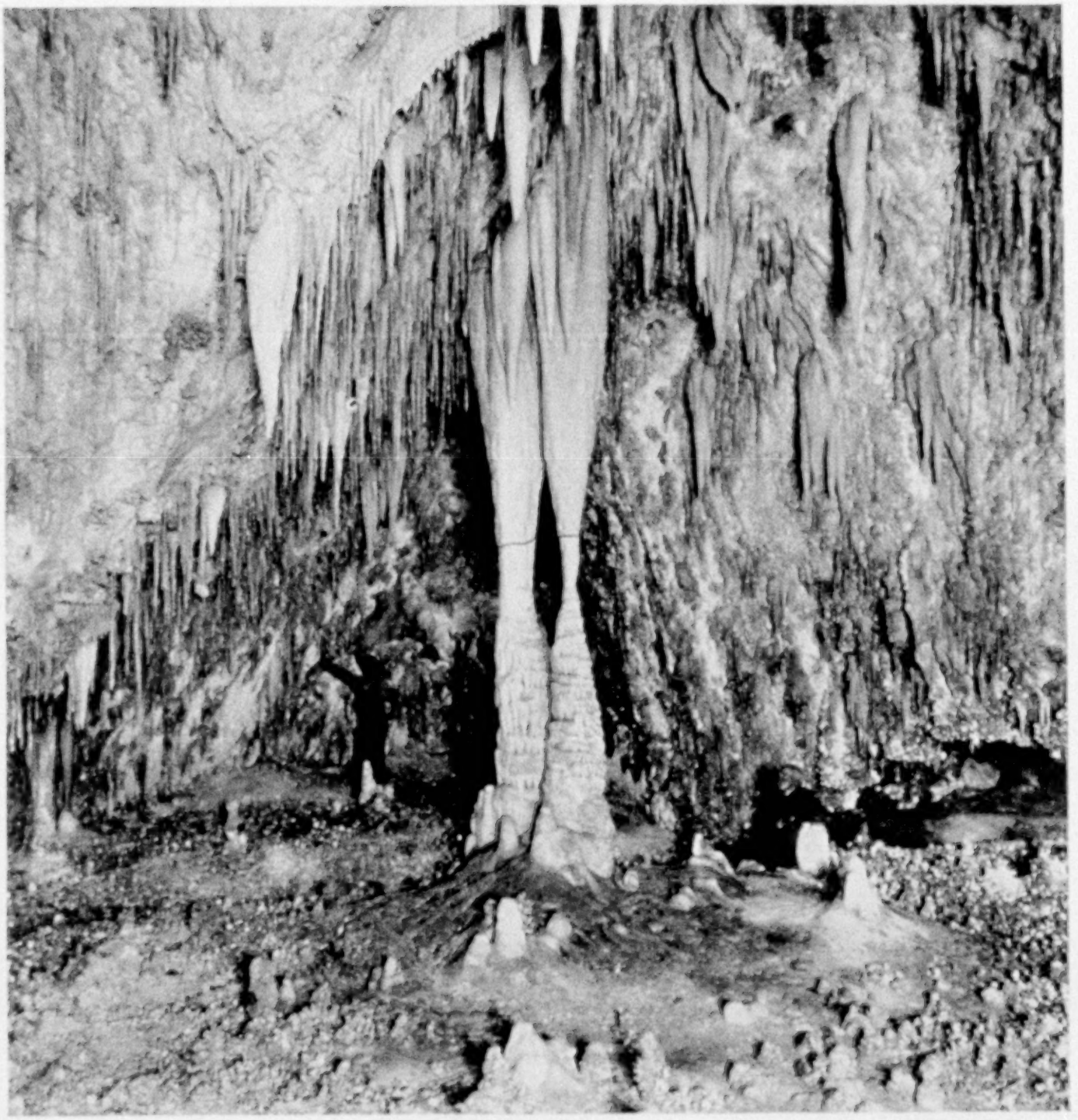
XUM



Photograph by Jacob Gayer

VIEW IN THE CENTER OF THE BIG ROOM IN CARLSBAD CAVERN

At the left are two fluted columns of cave marble. At the right of these columns is a party of tourists standing amid the numerous coralline stalagmites. In the distance appear the Twin Domes (see, also, illustration, page 311).



Photograph by Willis T. Lee

PILLARS IN ONE OF THE LOWER CHAMBERS OF CARLSBAD CAVERN BROKEN BY THE SETTLING OF THE FLOOR (SEE TEXT, PAGE 315)

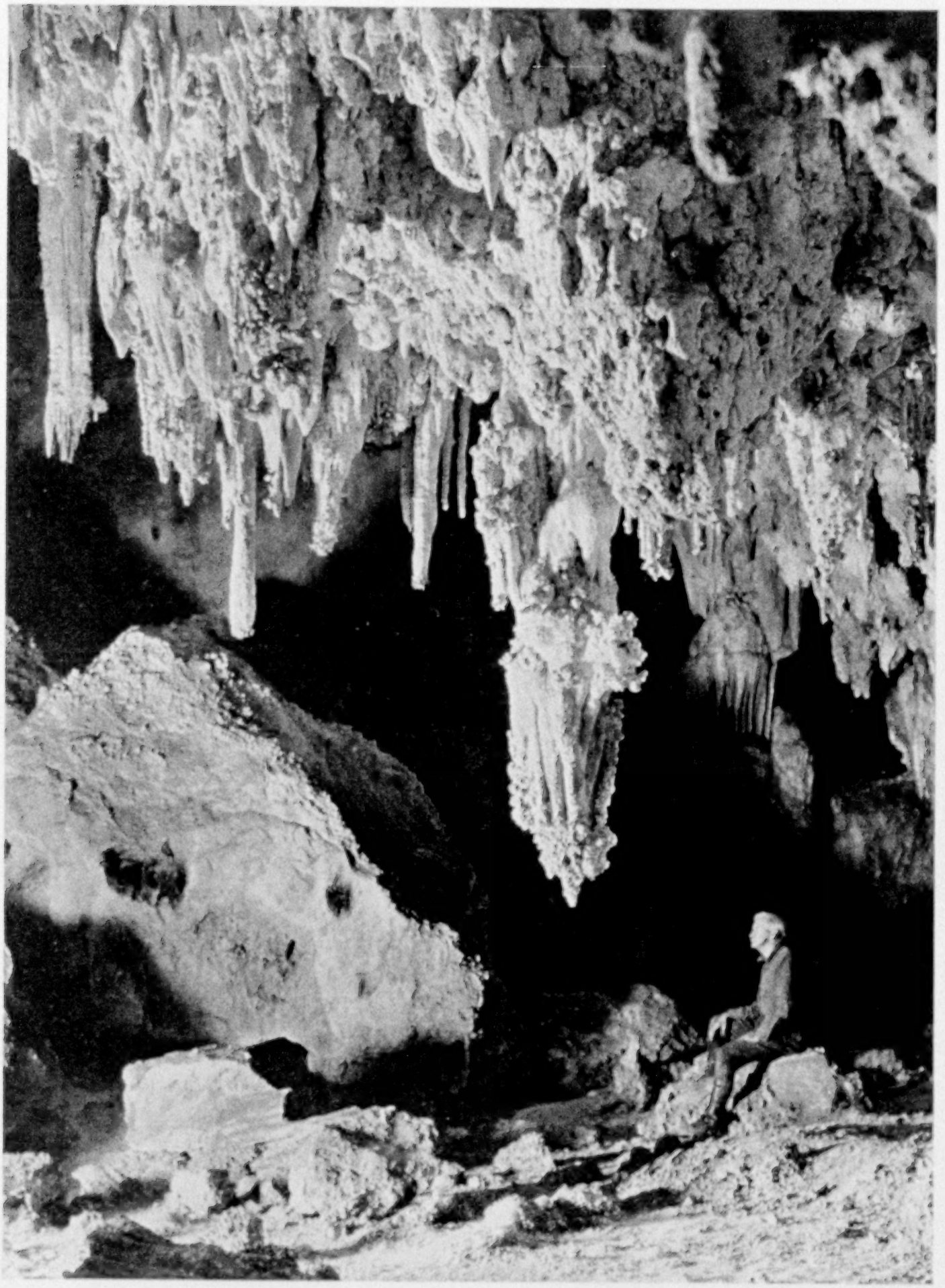
This chamber, nearly 1,000 feet underground, has been named after the Indians' Nooge, or Place of Darkness, at the base of the universe, where, according to their legend, there is no sun, no moon, and no light. The man in the left middle distance is Jim White, the veteran guide.

100 to 200 feet wide, with a ceiling which at some points is nearly 300 feet high.

Each morning we descended into the Stygian darkness, and by the uncertain light of lanterns picked our way over and around and between great blocks of rocks, working our way downward to Shinav's Wigwam, 830 feet beneath the surface, where the highly decorated parts of the cavern begin.

The chambers previously explored were used as points of departure for new discoveries. Tom Sawyer was emulated in the use of kite strings, and in time we had an elaborate system of avenues, with white twine markers all leading to the exit. If one became confused and uncertain as to direction, he followed the twine and soon came to the main trail.

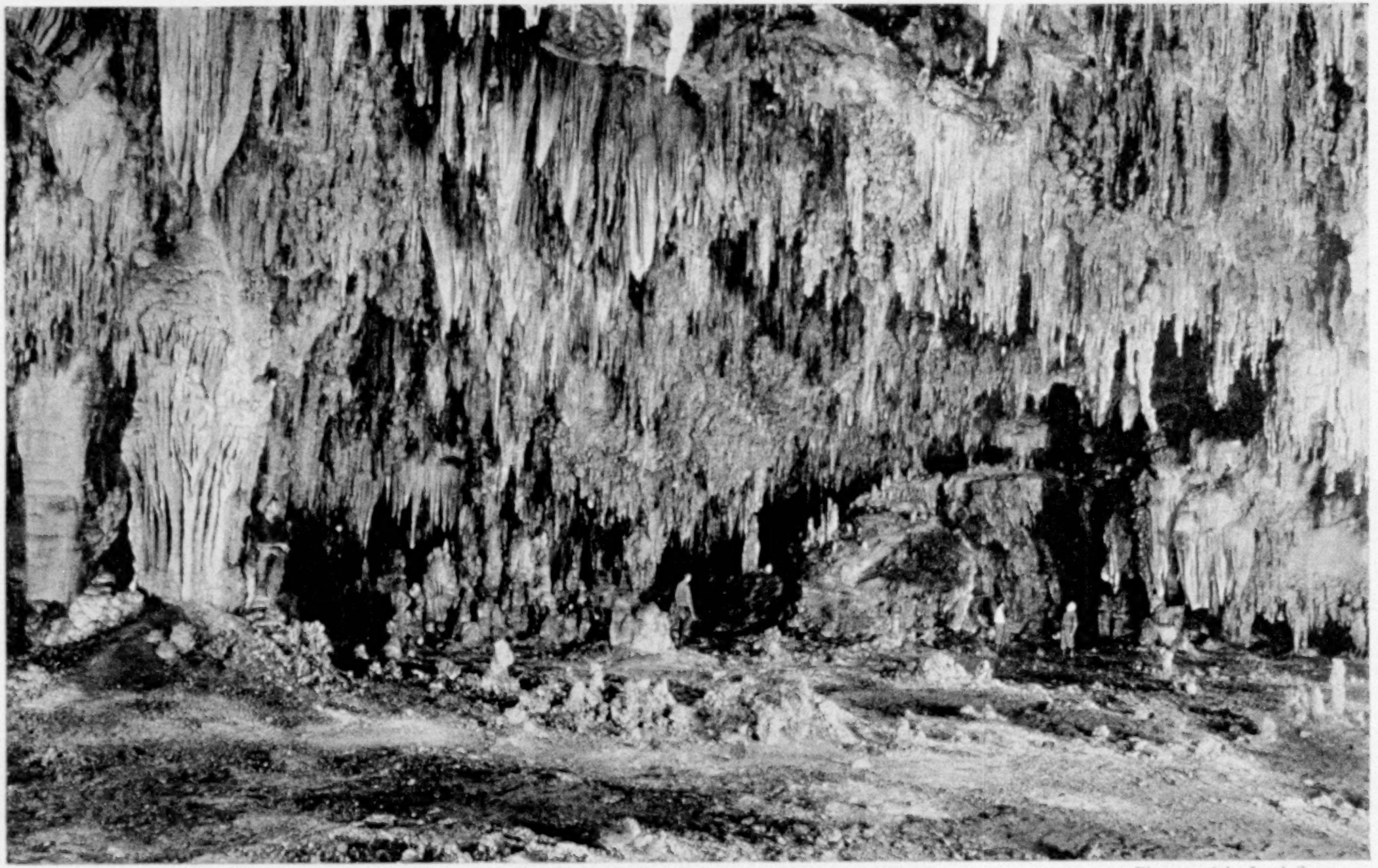
Amid unearthly scenes, I not infrequently lost my sense of direction and I found myself confused in places where I



Photograph from Willis T. Lee

THE ARMORY AND SHINAV'S WAR CLUB

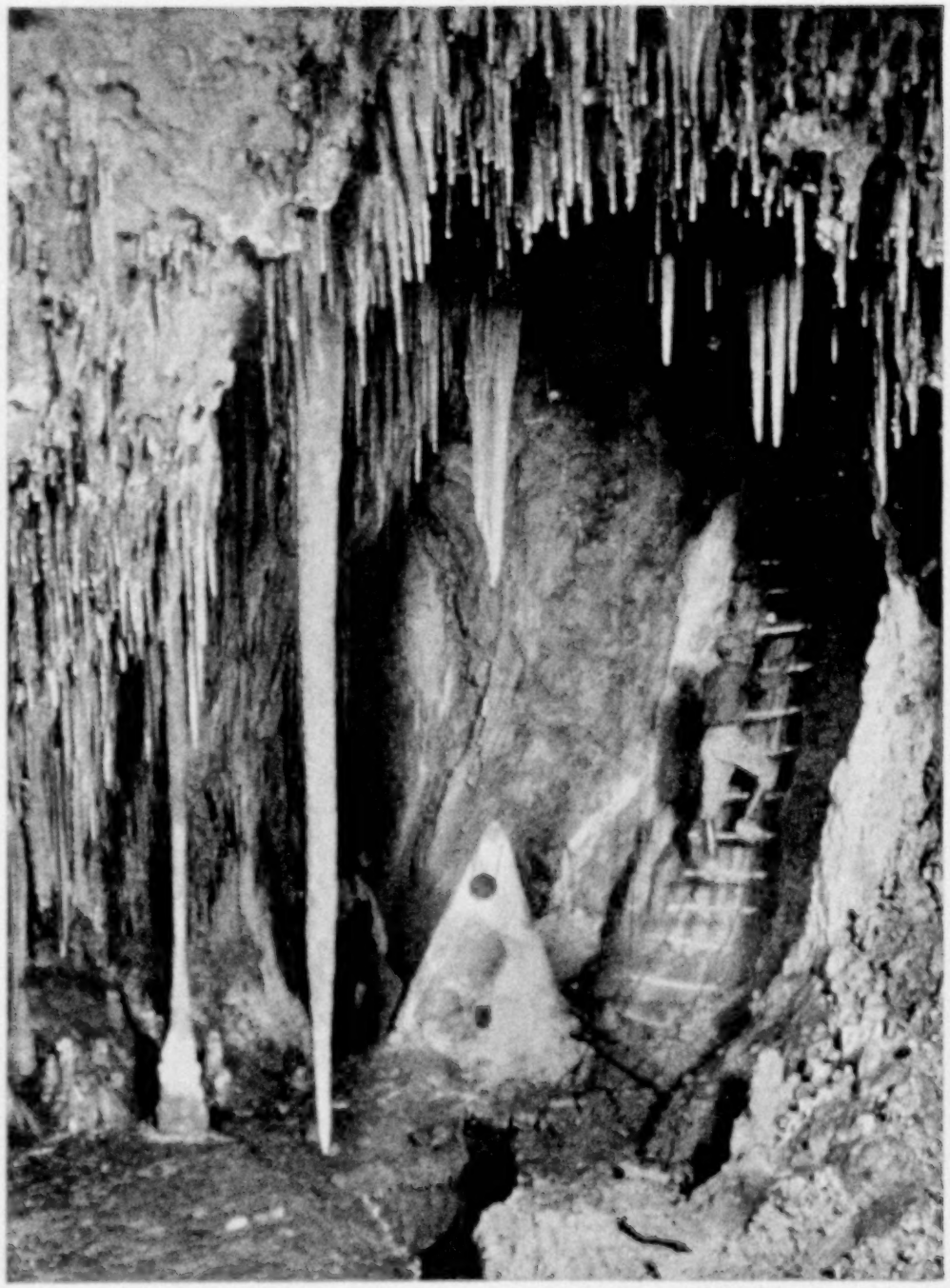
The entrance to Shinav's Wigwam is decorated with a great number of stalactites, whose gnarled appearance suggests the war clubs of cave men. Because of this suggestion the antechamber to the Wigwam has been called the Armory, or place where Shinav and his braves hung their weapons on returning from battle. The large stalactite of knotty aspect, to the right of which the author is seated, is called the war club of the Navajo's wolf god.



Photograph by Jacob Gayer

SHINAV'S WIGWAM, ONE OF THE MOST HIGHLY DECORATED CHAMBERS OF CARLSBAD CAVERN

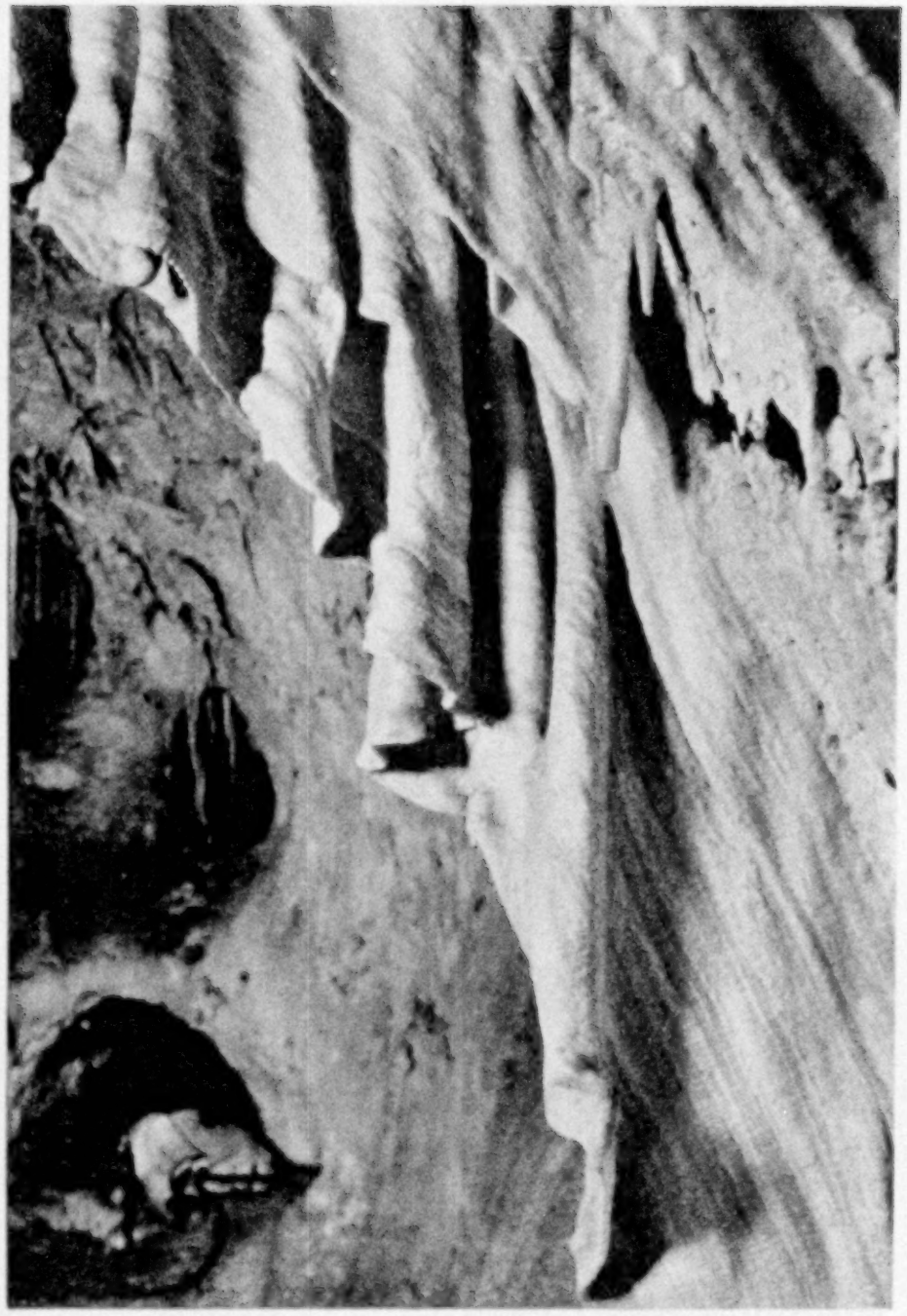
This chamber is nearly circular in outline, 200 feet across, and 75 feet high. The floor is nearly level and has twice the area of the great rotunda of the National Capitol in Washington. Small passageways through the walls lead into neighboring chambers of equally ornate adornment. The walls of the Wigwam are decorated with pendants and draperies of white onyx marble in bewildering variety of form. Although the great chamber originated as a solution cavity, the original limestone walls are nowhere to be seen. The native rock is completely covered with the marble decorations.



Photograph by Willis T. Lee

THE ENTRANCE TO THE LOWEST LEVELS OF CARLSBAD CAVERN

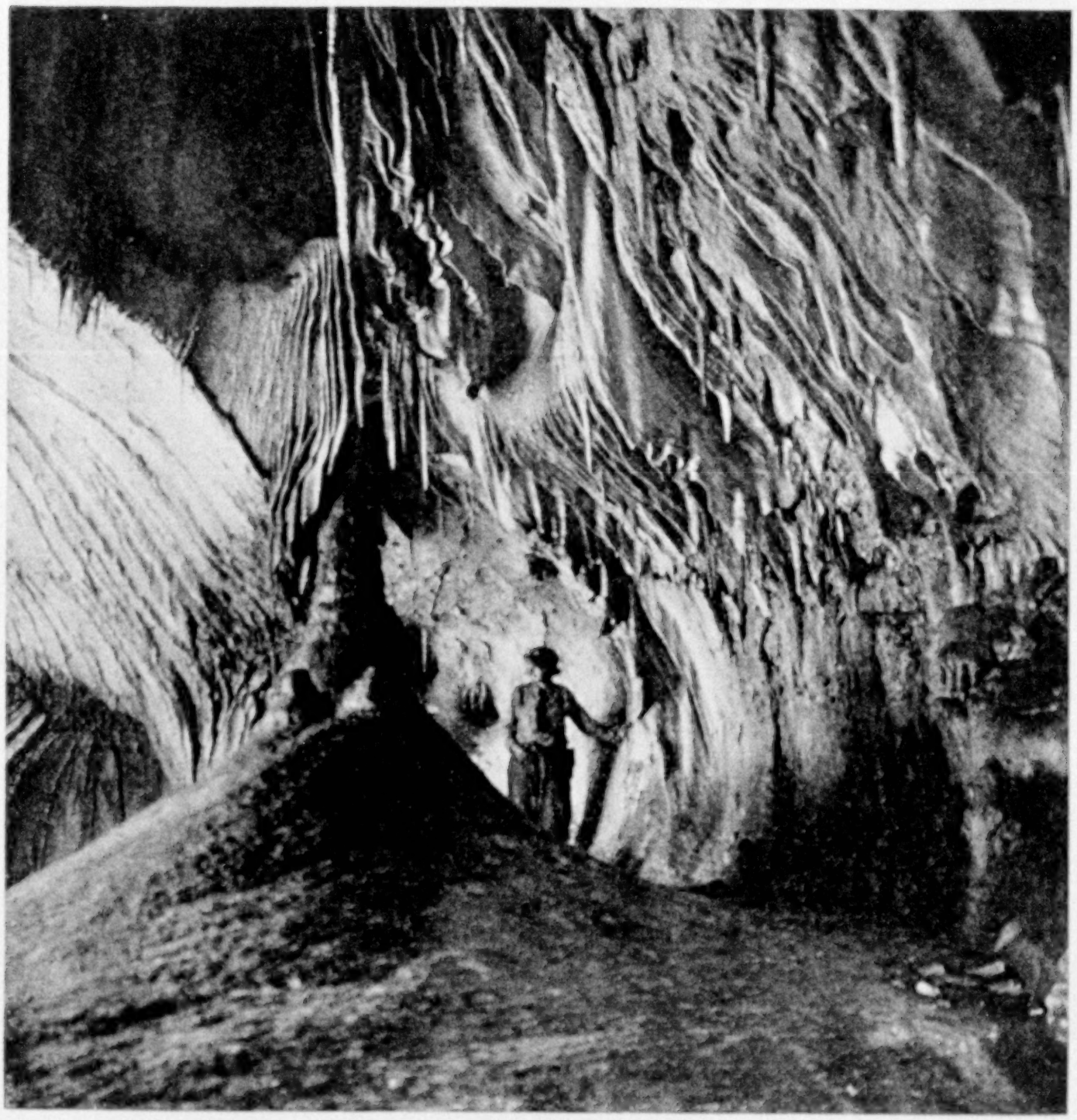
In the right background is the lower end of the 90-foot wire ladder by which the explorers reached this level (see text, page 314).



Photograph by Jacob Gayer

A CURTAIN FOLD OF CAVE MARBLE RESEMBLING A PORTIÈRE

So closely does this material resemble fabric that one is impelled to feel of it before he is convinced that it is cold marble.



Photograph by Willis T. Lee

THE TAPESTRY WALL OF THE DOME ROOM

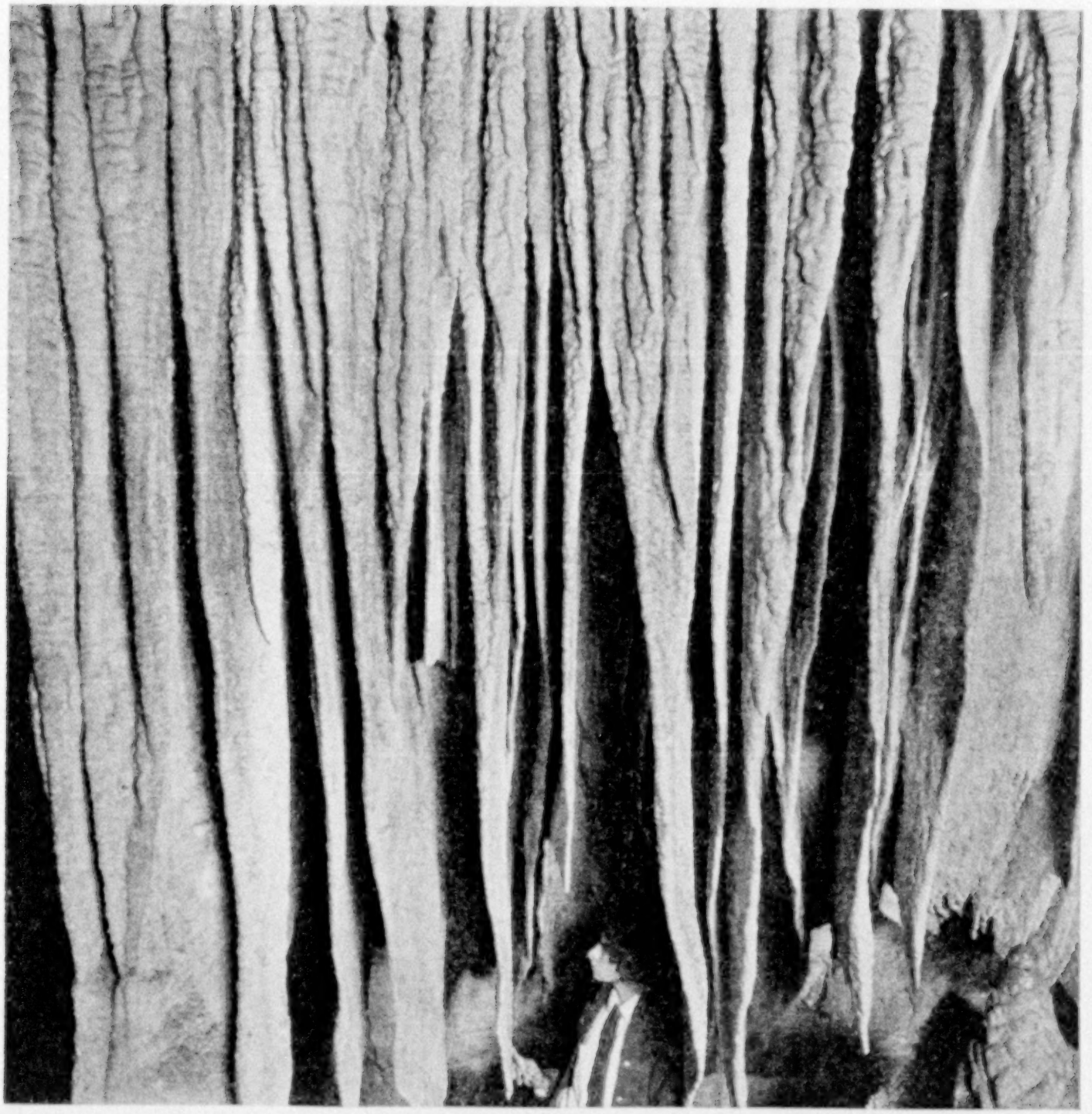
Many of the sheets of this stone drapery are translucent and less than an inch thick. Interesting effects may be obtained by placing lights back of the drapery in such a way as to bring out its varied color and texture. (For detail, see illustration, page 307.)

had been many times. All light available emanated from lanterns, so that what I saw at any one time was not an entire object, but the particular part of it that was illuminated. Thus, a familiar formation viewed from a new angle had a strange and unfamiliar aspect.

On this principle it will be possible, by the use of skillfully placed lights, which are soon to be installed by the National Park Service, to produce a great variety of spectacular effects in a restricted area.

One of the newly discovered chambers near Shinav's Wigwam was found when the surveyor's helper crept through a small hole in the wall of the Wigwam. The partition here is thin and a spectacular view, never before seen by human eye, opened to the astonished gaze of the venturesome assistant.

This new chamber, which we named Avanyu's Retreat, after the wise serpent of Indian mythology, contains several pools, about which are grouped many at-



Photograph by Willis T. Lee

A THEATER CURTAIN OF DRIPSTONE AT THE ENTRANCE TO THE MUSIC ROOM

Through uncounted ages water bearing carbonate of lime in solution has trickled from a crevice high in the wall, depositing its load of mineral matter in the form of a hanging curtain. Beyond this portière is a group of stalactites, which give forth musical tones when lightly touched (see text, page 313).

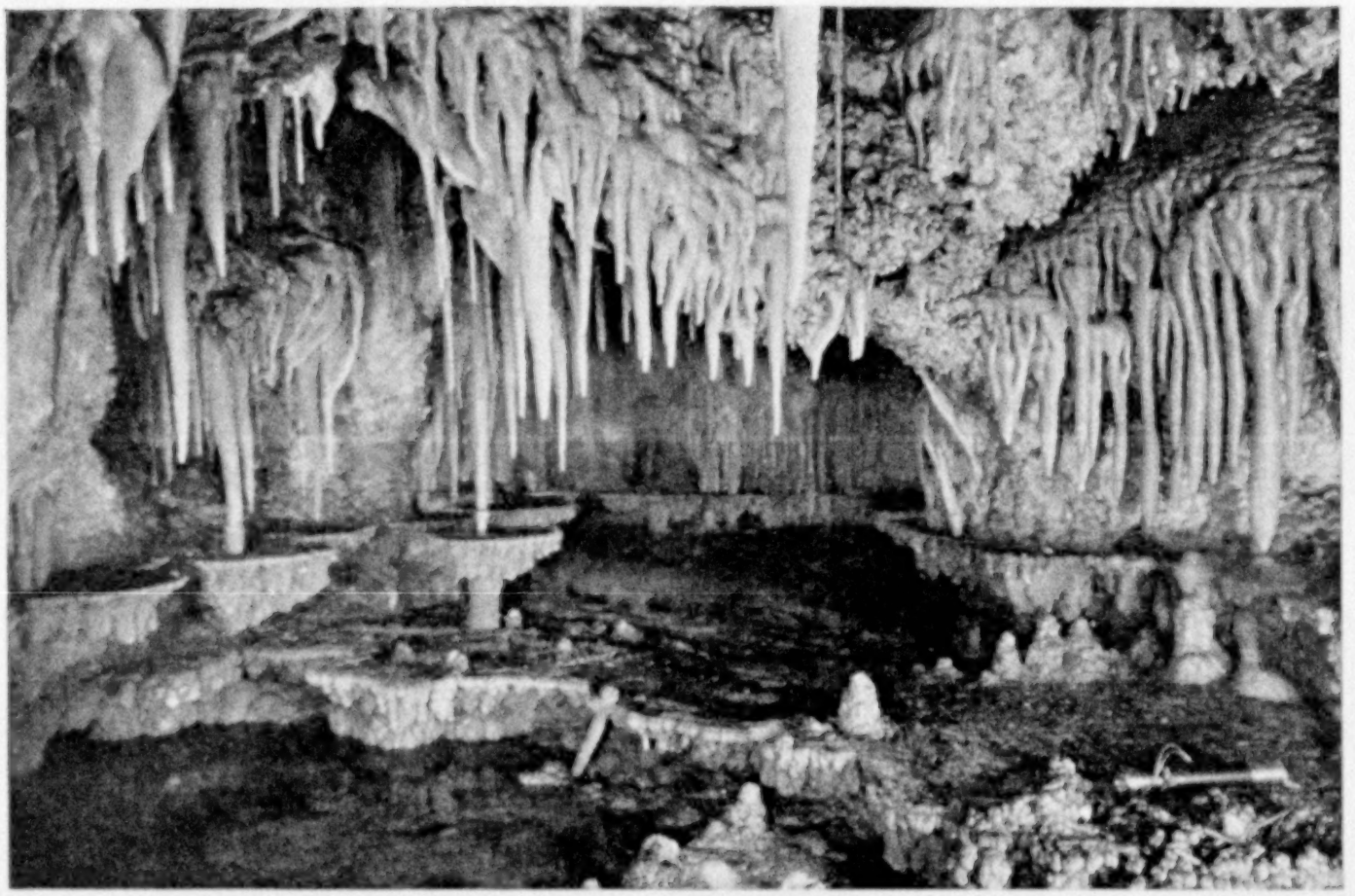
tractive decorations. One of the pools, which we called Mirror Lake, is about 150 feet long and is surrounded by delicately tinted onyx marble. The water of these pools appears deep blue in the white light of a gasoline lantern.

At the far end of the Retreat a good climber may make his way up a series of terraces of flowstone, about 30 feet high, to the Koo Vanyu, a chamber where the curious Medusalike formations known to science as helictites suggest the Piros' Koo Vanyu, or stone snakes (see lower illustration, page 310).

A HILL WITHIN A CAVERN UNDERNEATH A MOUNTAIN

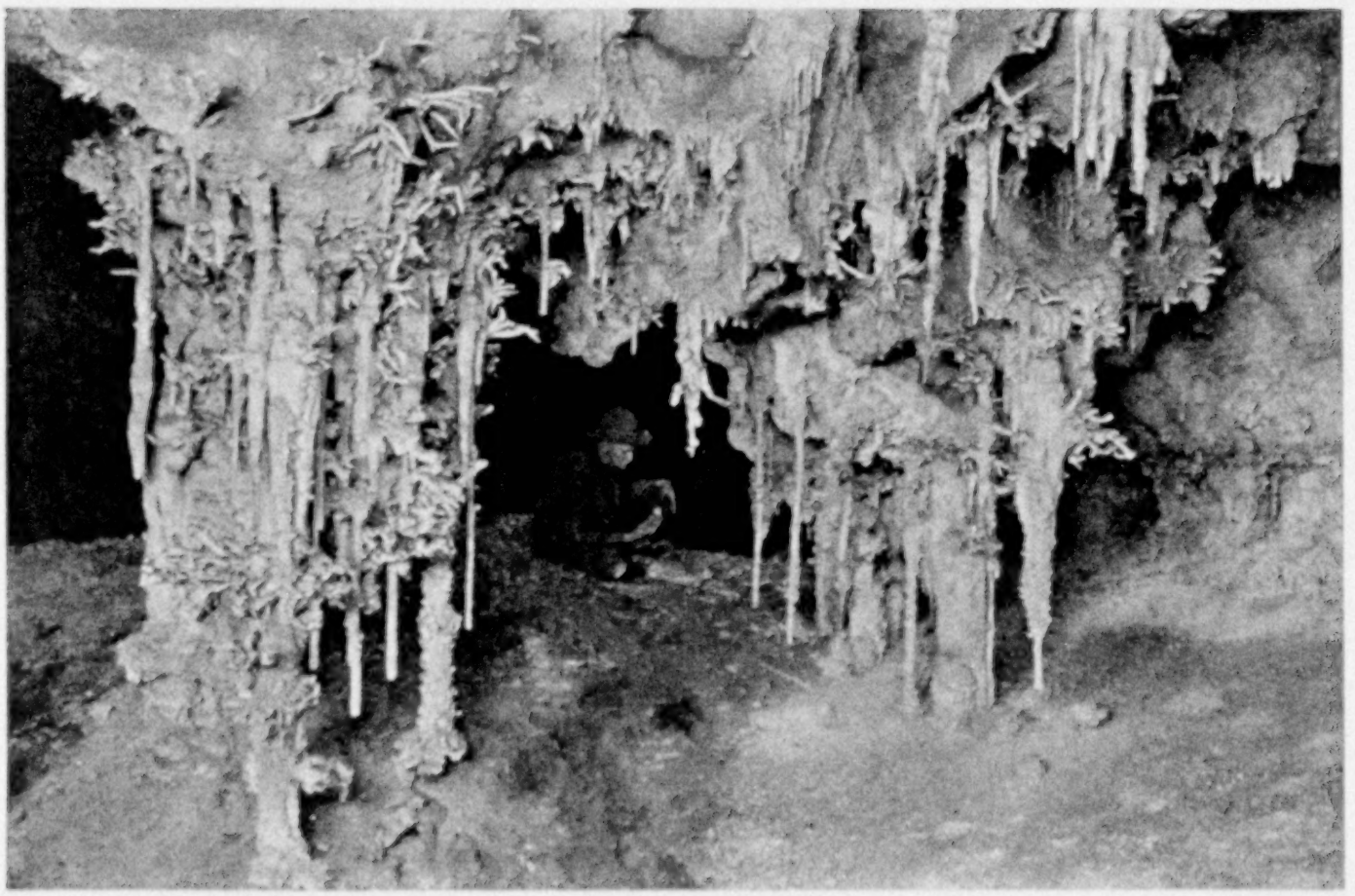
Many interesting nooks and corners about Shinav's Wigwam were thus explored and mapped; others, which are difficult of access, remain unknown.

On leaving the chambers grouped about



THE NECTAR FOUNTAIN

The white stalactites are the water pipes which supply the fountain, and the irregular shelf marks the maximum height of the water (see text, page 315).



Photographs by Willis T. Lee

EXAMINING THE "TREASURES" IN THE ANTEROOM OF SHINAV'S WIGWAM

Had the author of Arabian Nights seen the treasures of Koo Vanyu Loft, he might have enriched his tale of Aladdin and his lamp with facts stranger than the fictions used. The Piros name Koo Vanyu, or stone snakes, is suggested by the Medusalike groups of helictites which adorn the pillars and stalactites of cave marble.

© Ray V. Davis

TWIN DOMES AND A PILLAR IN THE HEART OF THE BIG ROOM

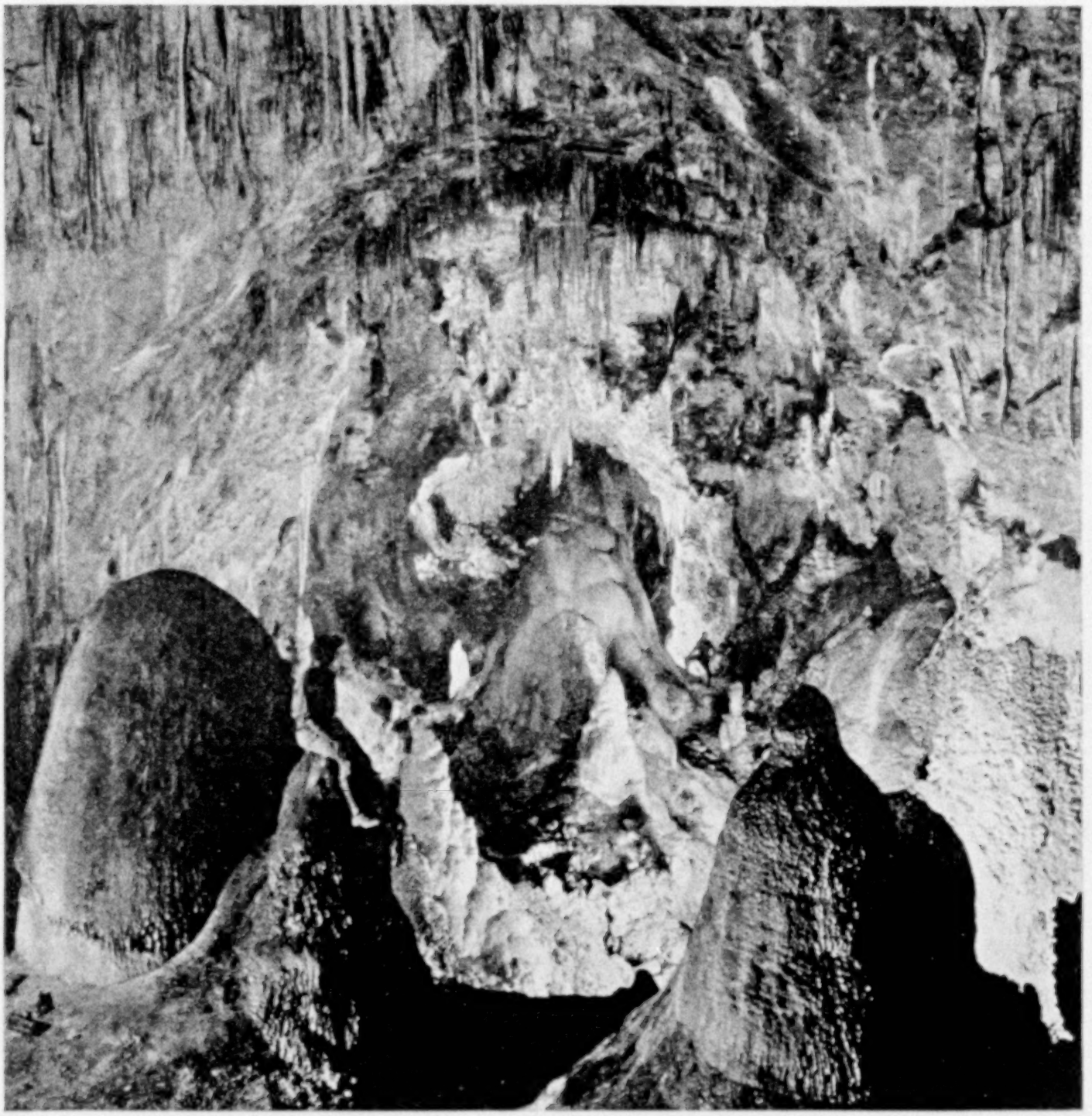
The great fluted domes of cave marble rise 39 feet above the top of a mound of flowstone about 200 feet across and 50 feet high (see, also, page 303).

the Wigwam we were obliged to build a trail over a steep hill in order to reach the more spectacular part of the cavern. Here the ceiling of the great corridor has fallen and huge blocks of limestone lie on the floor. One of these blocks is 140 feet in diameter—a fragment that would tip the beam of some titanic scale at many thousands of tons.

The high part of the corridor rises more than 350 feet above the floor of the Wigwam; how much more was not determined, for the upper part of the cavity could not be measured. In the original description of the cavern in the NATIONAL GEOGRAPHIC MAGAZINE, I estimated this height at 300 feet. The survey proved that this and other conjectures were underestimates.

On the side of the hill facing the Big Room, the blocks of limestone are covered with flowstone built up in beautifully terraced slopes, on which are fountain basins with bejeweled bowls.

We descended this terraced slope with care, for a false step might ruin many of



Photograph by Jacob Gayer

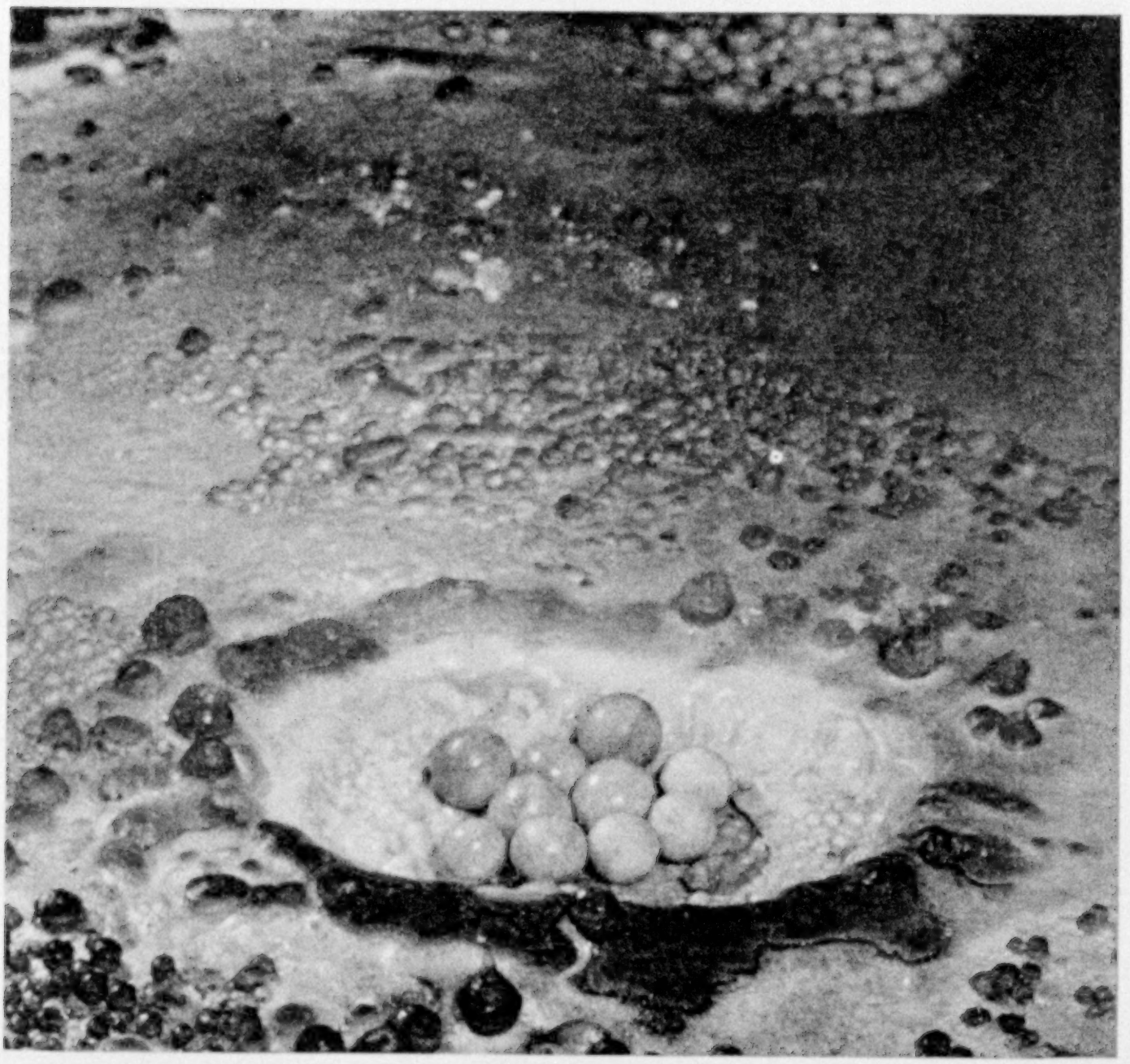
GENERAL VIEW IN THE BIG ROOM THROUGH THE ARCHED AVENUE BETWEEN TWIN DOMES AND DOH'S KIVA

Great stalagmites of cave marble rise half way to the adorned ceiling, from which thousands of stalactites hang like suspended daggers.

the delicate ornaments. But this was not the only reason for our caution. On one occasion I lost my footing and slid down a beautifully terraced slope studded with lovely but sharp and unyielding crystals. The effect of this mishap remains with me in the form of impaired eyesight.

The great cavity called the Big Room is surrounded by tributary chambers of which little was formerly known. Near the portal of this room, at the side of a great mass of onyx marble, we found a small hole. On stepping through it for the first time, I was startled at the magnificence of the scene which suddenly opened to view.

Here was a chamber, about 150 feet long, with walls and ceiling gracefully arched, which we called the Dome Room. From the arched vault hung pendants of ornate character, and on the wall were thin sheets of delicately colored onyx resembling portières looped back in graceful folds. One is impelled to touch these



Photograph by Willis T. Lee

PISOLITES ON THE FLOOR OF THE ROOKERY

These spherical bodies, about half an inch in diameter, are made up of concentric shells like pearls. This onion-shell structure results from deposition in water charged with calcium carbonate. Where the water from the ceiling drops with some force, a "nest" is formed and the "eggs" are prevented from becoming fast. The water flowing from the "nest" deposits sheets of rock material, which cements the previously formed "eggs" into a solid mass. These spherical bodies are known to geologists as pisolites and to jewelers as cave pearls (see text, page 315).

folds before he is convinced that they are cold, hard stone.

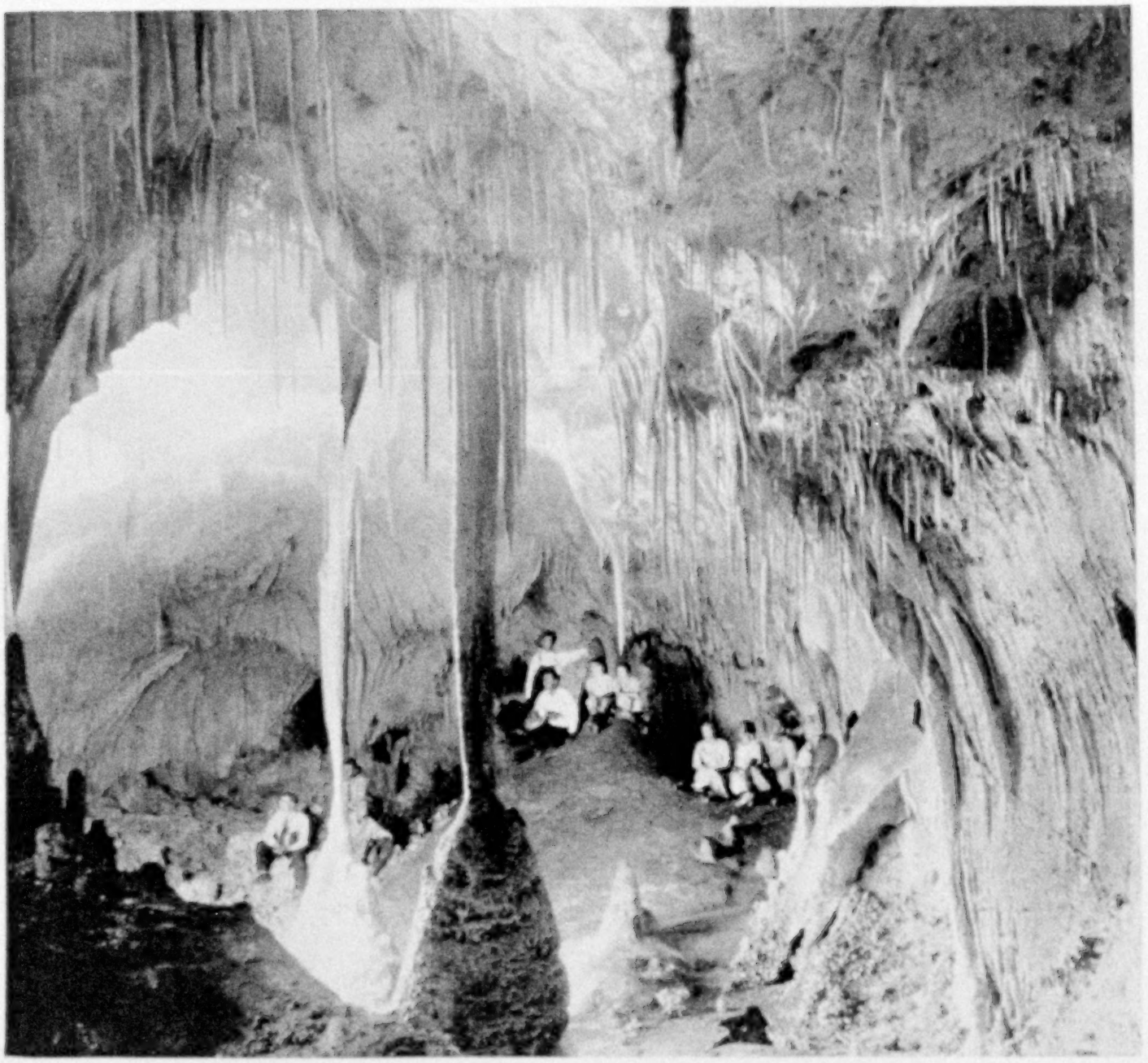
Another chamber, or series of chambers, near the Dome Room proved to be equally surprising, but in a very different way. A group of stalactites and stalagmites at the entrance suggests a giant portière (see illustration, page 309) and farther along a second group of stalactites gives forth musical tones when lightly touched.

One of the stalactites was accidentally broken and water began at once to flow from its central tube. It proved to be excellent drinking water, and we sipped from this natural spigot whenever we passed.

A SERIES OF CHAMBERS AT A LOWER LEVEL IS EXPLORED

Toward the right, as one enters the Big Room, the trail ordinarily used ends abruptly at the brink of a chasm, where one gazes into a pit 90 feet deep and nearly 300 feet across.

The domed ceiling of this spacious ro-



© Ray V. Davis

THE DOME ROOM, CHARACTERIZED BY GRACEFULLY ARCHED WALLS AND DOMED CEILING

This chamber is about 150 feet long by 50 feet wide, and is profusely decorated with pink and lemon-yellow marble in forms which baffle description. The two slender pillars rise from a fountain basin of crystalline onyx marble, which has formed at the surface of the water in shapes resembling lily pads. Many of the pendants and thin sheets of marble are in the form of wavy folds of drapery.

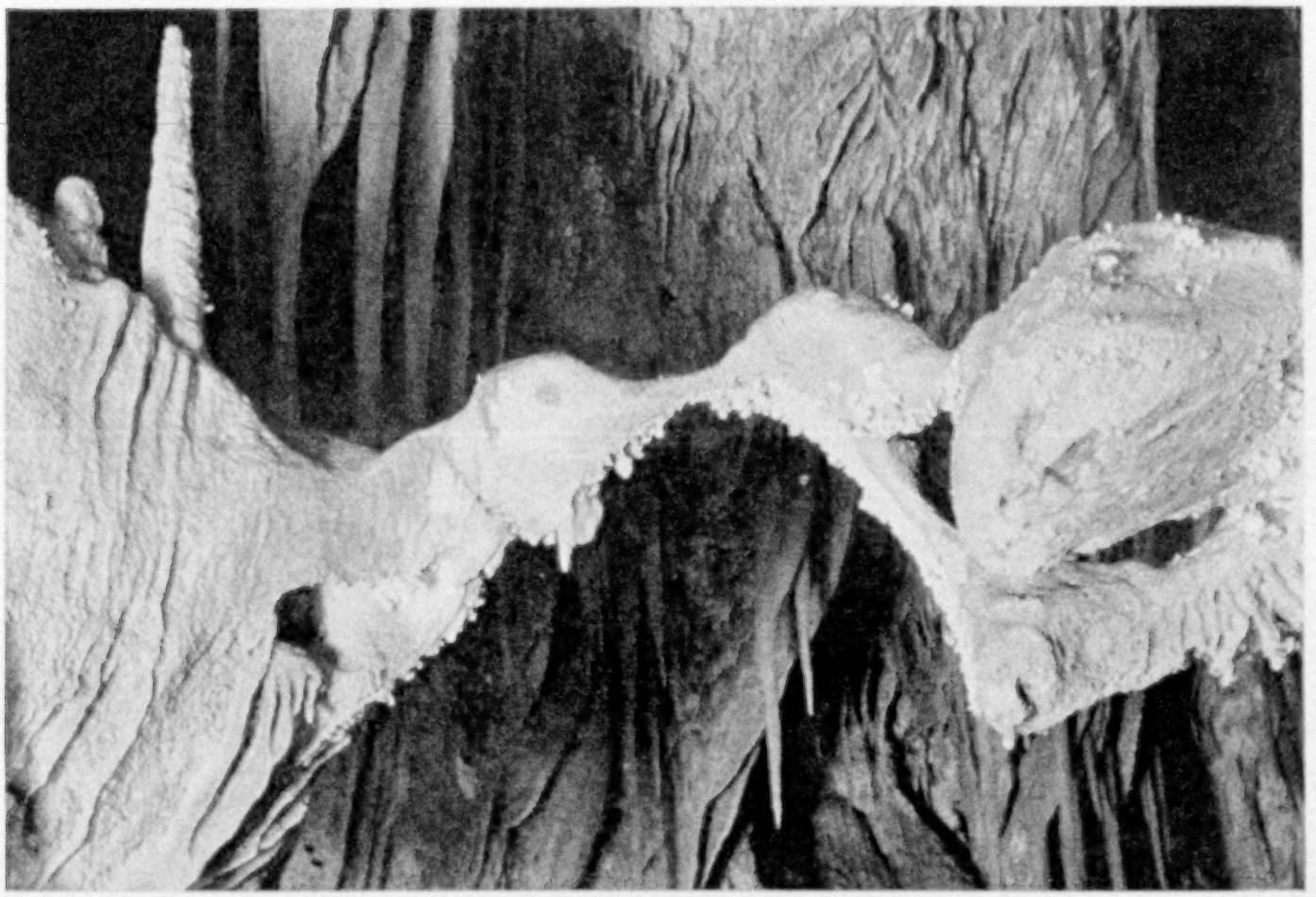
tunda is about 200 feet from the floor of the pit and is decorated with pendants of onyx marble, while the walls are adorned with tapestrylike trappings of flowstone.

Wire and rungs were brought into the cave and a ladder was constructed. This was lowered over the brink, the lower 75 feet of the ladder swinging clear of the wall (see illustration, page 307).

A wire ladder has an erratic nature and an obstinate disposition; it has a tendency to be where it does not belong. Those who first descended had an unhappy time swaying and spinning about in the darkness. Later the ladder was anchored, but those affected with weak nerves did not enjoy the climb.

At the foot of the ladder we found ourselves in a highly adorned corridor about 150 feet long, with a floor composed of a succession of fountain basins partly crusted over with onyx marble, formed about the rim at the surface of the water as ice forms over a pool.

Before the ladder was built, Jim White, the guide, went down the hole on a rope.



Photograph by Jacob Gayer

THE "BILLING DOVES"

A curious remnant of limestone has been left by the solution of the rocks about it. The resemblance to birds' heads is striking when viewed from a certain point. Such freaks in the great solution cavities of Carlsbad Cavern keep observers busy imagining resemblances to familiar objects and suggesting analogies.

He carried a kerosene torch, which gives little light and much smoke. By such fitful gleams things look weird and unreal. All went well until he reached the water at the bottom of the hole. To his perturbed mind this seemed like an ocean. His frantic signals to be raised were misunderstood and he was dropped unceremoniously into the pool. With light gone, he passed an unhappy moment in pitch darkness before he discovered that he could touch bottom.

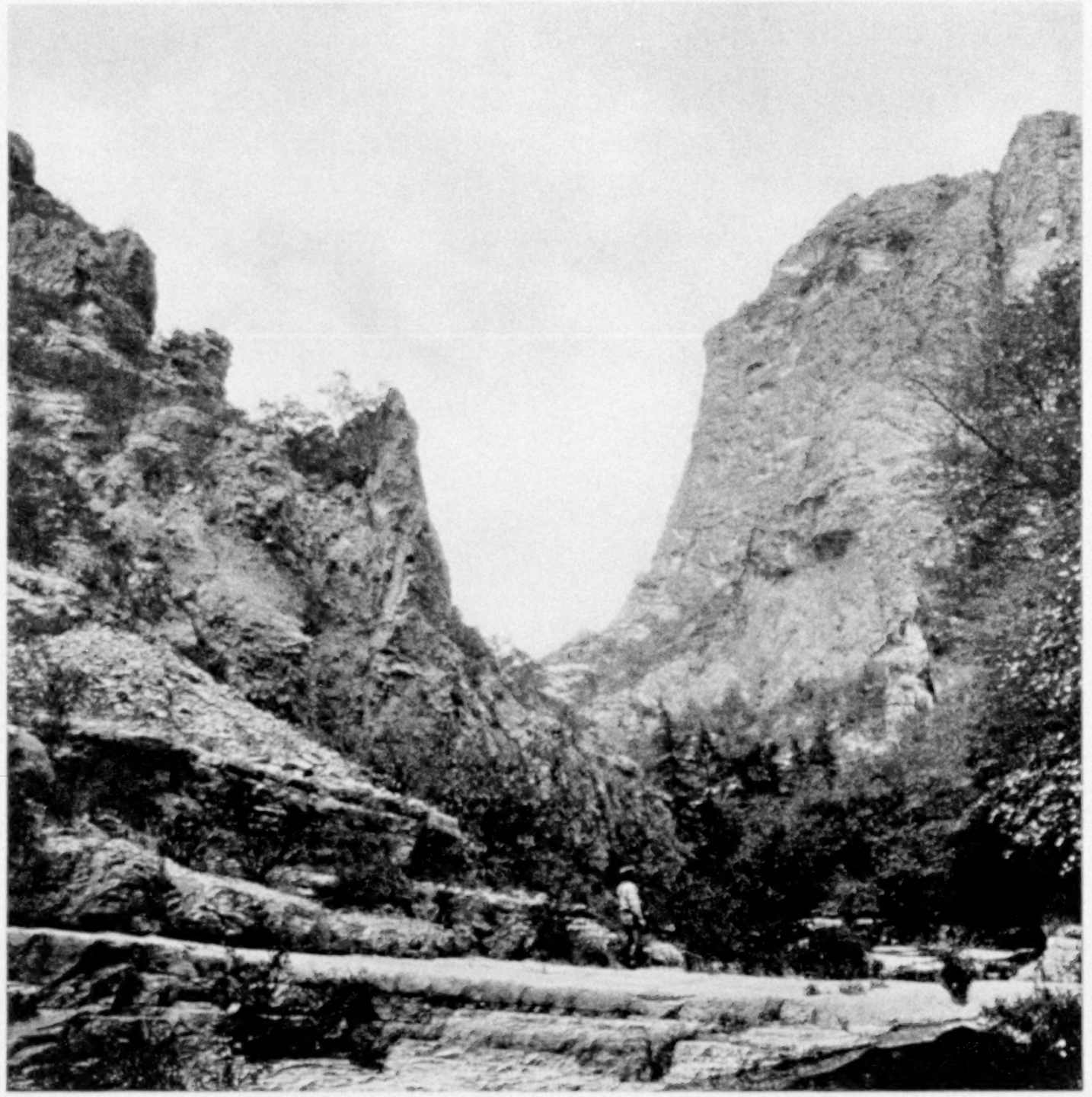
Under the dome stand numerous stalagmites, like pedestals in a hall of fame; over them hang great pendants, like sharp-pointed daggers. One instinctively stands from under the great masses which seem so precariously fastened, for the fact that they have hung securely for thousands of years does not reassure the nervous explorer. Especially is this true as he stands beside a mass of similar material which *did fall*—a mass which would weigh 100,000 tons and which fell 200 feet from the ceiling!

Of the two main avenues leading from this central rotunda back into mysterious places, that to the left is profusely decorated, the stalactites seeming to push forward for attention, as if each were trying to say, "Behold me! In this basal darkness I have waited 10,000 years for one admiring glance."

A surprising phenomenon was found here. Solution is gradually removing material and the floor is slowly sinking, with the result that great columns have been snapped asunder and drawn apart (see illustration, page 304).

A DRINKING FOUNTAIN WORTHY OF THE GODS

The avenue to the right leads to the Rookery, so called because of its many egglike bodies of cave marble. Over a considerable area the floor is covered with these bodies, known to geologists as pisolites and to the jeweler as cave pearls. The "eggs" occur singly and in groups. Some have grown fast to the floor; others



Photograph by Willis T. Lee

A CAMPERS' PARADISE IN THE NEW TEXAS STATE PARK (SEE PAGE 301)

The precipitous limestone walls rise sheer from the waterholes, where the deer and bighorns come down to drink and where an occasional bear, unaccustomed to the ways of man, comes to inquire as to the state of the camp supplies.

are unattached, probably because of the slight rocking motion imparted to them by the water dripping from the ceiling (see illustration, page 313).

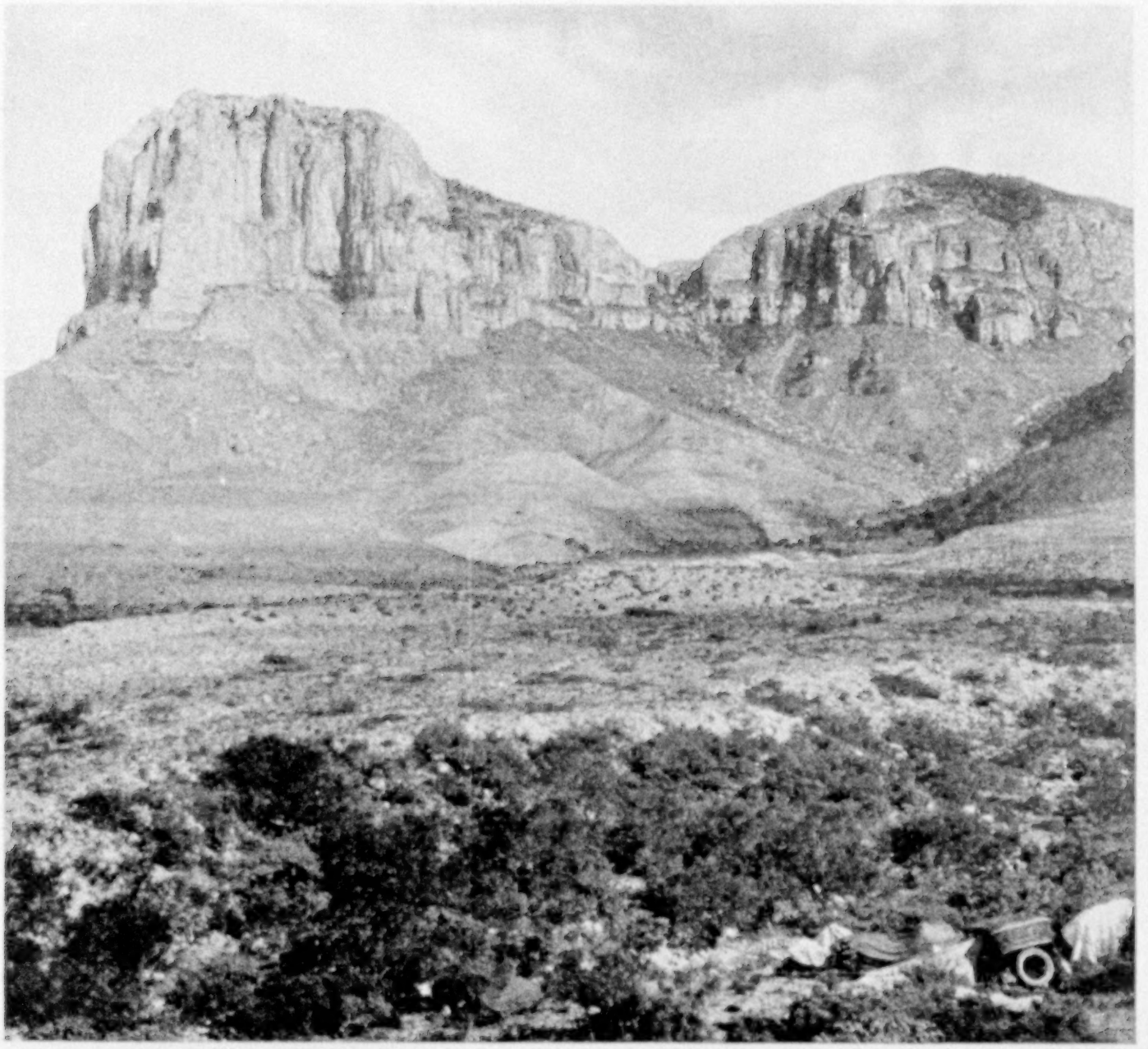
Like real pearls, these cave pearls are built up layer on layer by calcium carbonate deposited from the water. Some of them have smooth, glistening surfaces; others have a dull luster.

An alcove of unusual beauty was found near the Rookery. We entered through a maze of pendants, some of which were destroyed in spite of all precautions. Within the alcove is a pool of water so beautifully adorned that we called it the Nectar Fountain (see page 310).

PICTURESQUE MOUNTAINS AND DESERT PLAINS

As exploration was extended beyond the Rookery, we found that the basement chambers turned and came back under the middle of the Big Room.

The mountains and plains in the vicin-



Photograph by Willis T. Lee

THE HEART OF THE NEW TEXAS STATE PARK (SEE MAP, PAGE 232)

In the right foreground is the National Geographic Society Expedition's camp at the water hole in Guadalupe Canyon, at the base of a magnificent escarpment which rises a vertical mile above the plain.

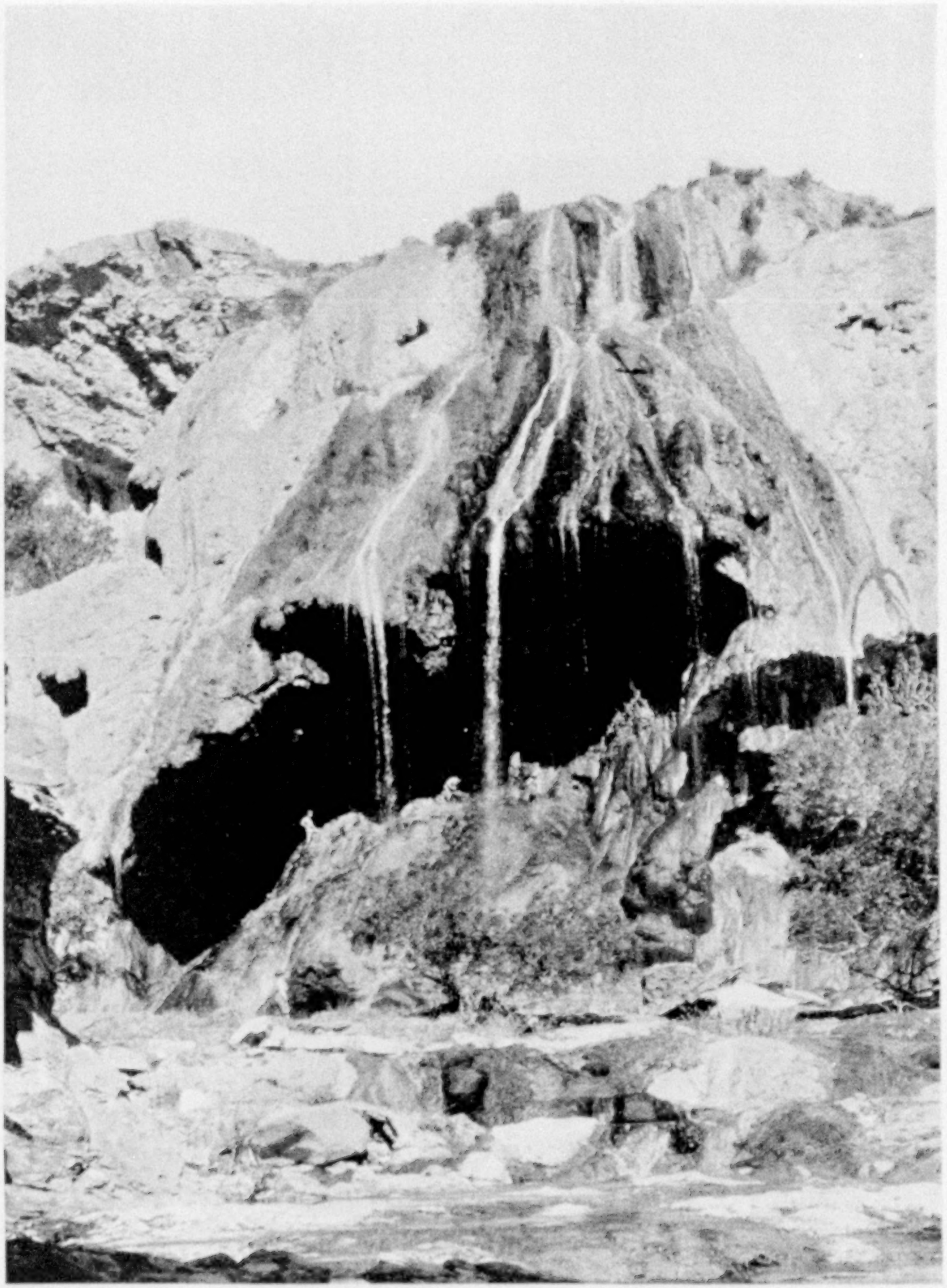
ity of the national monument are scarcely less interesting than the cavern itself. It is a land of alkali flat and soda lake; of sun-parched slope and barren crag; of cactus and mesquite; a land of coyotes, and rattlesnakes, and horned toads.

The characteristics of the desert are everywhere in evidence. The prairie dog chatters and scolds at one's approach, and with a saucy flip of his stubby tail disappears into his burrow. The jack rabbit bounds away on his angular course over the bunches of broomweed and between the thorny shrubs. The hot, dry whirlwinds raise spirals of pungent dust, which quiver in the shimmering atmosphere.

The spell of the desert is here: it is the Wild West, the land of adobe shack, of range cattle and goats. The picturesque cowboy in sombrero and chaps is a familiar figure, and although the bandit no longer roams at large, men still living tell of adventures with Billy-the-Kid and Black Jack.

One of the old pioneer trails, a route of the gold seekers of '49, known as the Butterfield Trail, crosses this plain. The old-timers remembered the whitened bones of the oxen that perished on the long stretches between water holes.

The Guadalupe Mountains rise from the plains like a rampart out of the sea. Far from the ordinary lines of transcontinental travel, few eyes have beheld their



Photograph by Willis T. Lee

SITTING BULL FALLS, NEAR QUEEN, NEW MEXICO

The water with calcium carbonate in solution issues from the rocks high in the canyon side and flows over the rim, where it has built a canopy of travertine, which roofs a cave about 100 feet deep. Note the human figures against the black background of the cave.

Photograph by Jacob Gayer

A YOUTHFUL SHEPHERD AND HIS NANNY: NEW MEXICO

The piles of rock are shelters from the sun's heat, to which the young goats are very susceptible.

glories. A great earth block composed chiefly of limestone has been lifted until its crest is more than a mile above the plain. Erosion has carved this block into a series of deep gorges and crested ridges.

Among the crags of these rock-ribbed fastnesses live bighorn sheep and bear and deer. Along the streams in the canyons are delightful camp sites, where wild creatures come down to drink, and where a friendly bear occasionally interviews the camper and inquires as to his intentions of remaining where he is not particularly welcome (see pages 316 and 317).

From these camping places near the streams and springs the limestone walls rise in rugged grandeur. I know of no place in America where the trailmaker and the landscape artist can find more spectacular effects.

On a properly constructed trail, in a day's trip in the saddle, one could pass from desert plain, over a craggy mountain slope, to a crest more than 9,000 feet high.

In this region, adjacent to the southern border of New Mexico, Texas has selected an area (see map, page 232) for a State park.

Photograph by Willis T. Lee

THE NATURAL OPENING TO CARLSBAD CAVERN (SEE MAP, PAGE 302)

The author of "Bats of the Carlsbad Cavern" is seen catching bats with his net (see text, pages 321 to 330).

BATS OF THE CARLSBAD CAVERN

By Vernon Bailey

Biologist, Biological Survey, U. S. Department of Agriculture

BATS—celebrated in art, story, and drama as emblems of evil and darkness, associated with Satan and the infernal regions, supposed to be teeming with vermin and prone to entangling alliances with ladies' hair—are one of our least-known and most-maligned groups of mammals; least known because they are highly nocturnal and rarely seen except in semidarkness, and because in daytime they hide away in dark places, which are rarely accessible except to prying naturalists.

Many intelligent people ask whether they are reptiles or birds, and my boy scouts always want to know whether I mean leatherwing bats or bull bats.*

So strong are superstition and imagination that constant reiteration of some of the well-known facts regarding the habits of bats seems necessary to an appreciation of their great value to man.

Bats are mammals of a very old and highly specialized group. They were hanging upside down in caves long before the first cave man came to join them; and, while they may not have acquired great mental powers, they have developed special senses of which man has little knowledge or appreciation. They have progressed along so many different lines that they now form one of the very large orders or groups of the mammals of the world, represented in America by numerous families, genera, and species.

Many of the families and genera are world-wide in distribution, and in G. S. Miller's latest list of the Mammals of North America 252 species of bats are given. Still, to most people a bat is a bat, without regard to a wide range of habits and structural differences.

BATS ARE CLAD IN FUR AND HAVE SHARP TEETH TO CHEW THEIR FOOD

Although clothed in fur instead of feathers, their powers of flight are comparable to those of birds, or even superior for their purposes. On their wide, elastic wings they can fly slowly or rapidly, and make the necessary short turns in air to capture their insect prey.

With minute eyes and apparently short range of vision, and even with eyes covered, they detect and capture their prey in the air, avoid all solid objects, or even the finest wires or strings stretched in their paths, and find their way through long and intricate passages with no trace of light to guide them.

Strangest of all, they wander far and wide over the country at night in search of food, and with unerring sense return at daybreak to the same place to sleep, and guided in some way unknown and incomprehensible to us, some make migratory journeys north and south over continental areas and wide stretches of ocean.

BATS FEED RAPIDLY AND CONSUME GREAT NUMBERS OF HARMFUL INSECTS

All of the bats of America north of the Tropics are entirely insectivorous, feeding upon and controlling the abundance of the night-flying insects, just as the birds do the daylight species. They feed rapidly and consume great numbers of insects; their stomachs are large, and after a half hour of feeding sometimes weigh a quarter as much as the whole animal. On the basis of only two full meals in a night, which may be far too low an estimate, bats would consume half their weight in insects every 24 hours.

The insects eaten are not easily identified, as bats have good teeth and chew their food to the finest bits. The wing scales of moths and the hard particles—jaws, legs, shells, and wings—of beetles and flies form a large part of the recognizable stomach contents, but other night-flying insects are also extensively eaten. Mosquitoes, gnats, and such delicate insects are rarely recognizable in their food, but undoubtedly form some part of it.

So far as we know, the insects eaten are mainly our enemies and might, in unchecked abundance, injure or destroy our forests and crops.

* It seems almost unnecessary to say that "bull bats" are nighthawks, birds related to the whip-poorwill.

A BAT WITH EARS UNROLLED AS IT AWAKENS

When the bat is cold and torpid in hibernation its ears are coiled up at the sides of the head. This one is warming up in the sunlight and the ears are slowly uncoiling (see, also, text, page 329).

Photographs by Vernon Bailey

BAT HELD IN FRONT OF CAMERA TO SHOW THE EARS

The antitragus, a slender filament inside of the ear, is supposed to be a delicate instrument for catching waves of sound or motion.

It is not improbable that bats are as necessary as birds in preserving that balance of Nature which renders this earth a reasonably comfortable habitation for man.

On close acquaintance, bats are found to be intelligent animals with very interesting habits. They are cleanly and not more subject to parasites than other animals. The chinchbug sometimes carried by them is not the species which infests our houses and causes so much annoyance.

There is no record of bats ever becoming entangled in the hair of anyone, and nothing could be further from their habits or inclinations. They will bite and fight savagely in self-defense, if captured and held against their will, but if handled gently they are quiet and intelligent, and in captivity soon learn to watch for the hand that feeds them.

MOTHER BAT CARRIES HER YOUNG IN FLIGHT

Most species of North American bats have but one young a year, born in June and carried about by the mother until old enough to fly and catch its own food.

The young are very large at birth, in some species weighing a quarter as much as the mother. They have no nests, but as the mother hangs head downward, by her hooked hind claws, the young cling to her body or are folded under her wings, where the two nipples are conveniently

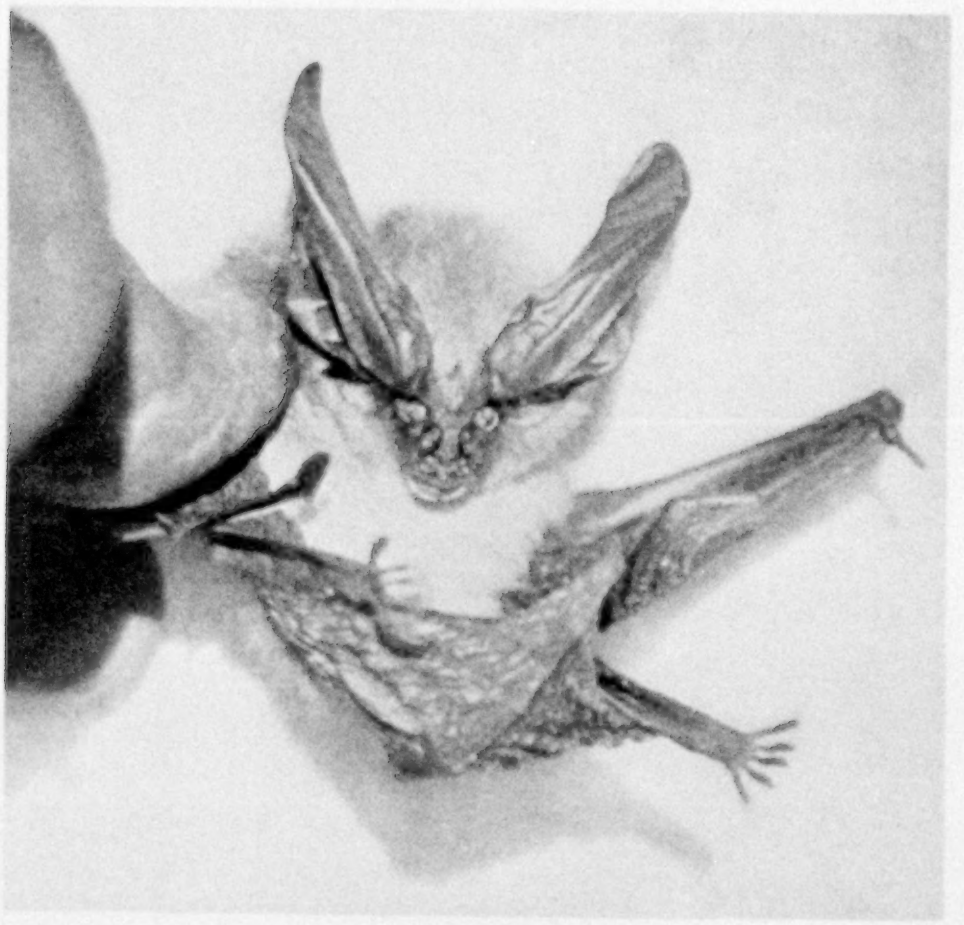
arranged on the sides of the breast, just above the cradle of her warm, fur-lined armpits.

During the mother's flight the young, even when half grown, cling to her body and are carried about in her nightly search for flying insects. They fly considerably before becoming full grown, and apparently develop very rapidly from birth to the time of their first flight.

The mating season of most of our bats is in late summer or autumn, but the embryos usually show little development until the following spring.

Soon after the bats in the Carlsbad Cavern awoke from hibernation the embryos were still minute and in some individuals could scarcely be detected. In others they were perfectly formed, with a well-developed vascular system. By April 24 they were as large as small buckshot, and by May 7 the size of a .44-caliber bullet. They steadily increased in size until June 13, when they were fully developed, as large as marbles, and ready for birth. One examined on this date weighed 3.6 grams, while the mother weighed 13.6 grams.

The birth of these young, fully a quarter as large as the mother, would not be possible except for the low and widely separated bones of her pelvis. Even then it is almost inconceivable that she could give birth to a young comparable to a 33-pound, two-year-old child of the human mother.



Photograph by Vernon Bailey

THE FACE OF AN ANGRY BAT

Caught and held in front of the camera against their will, these mammals express their rage with fierce looks and squeaks and use their keen little teeth on anything within reach.

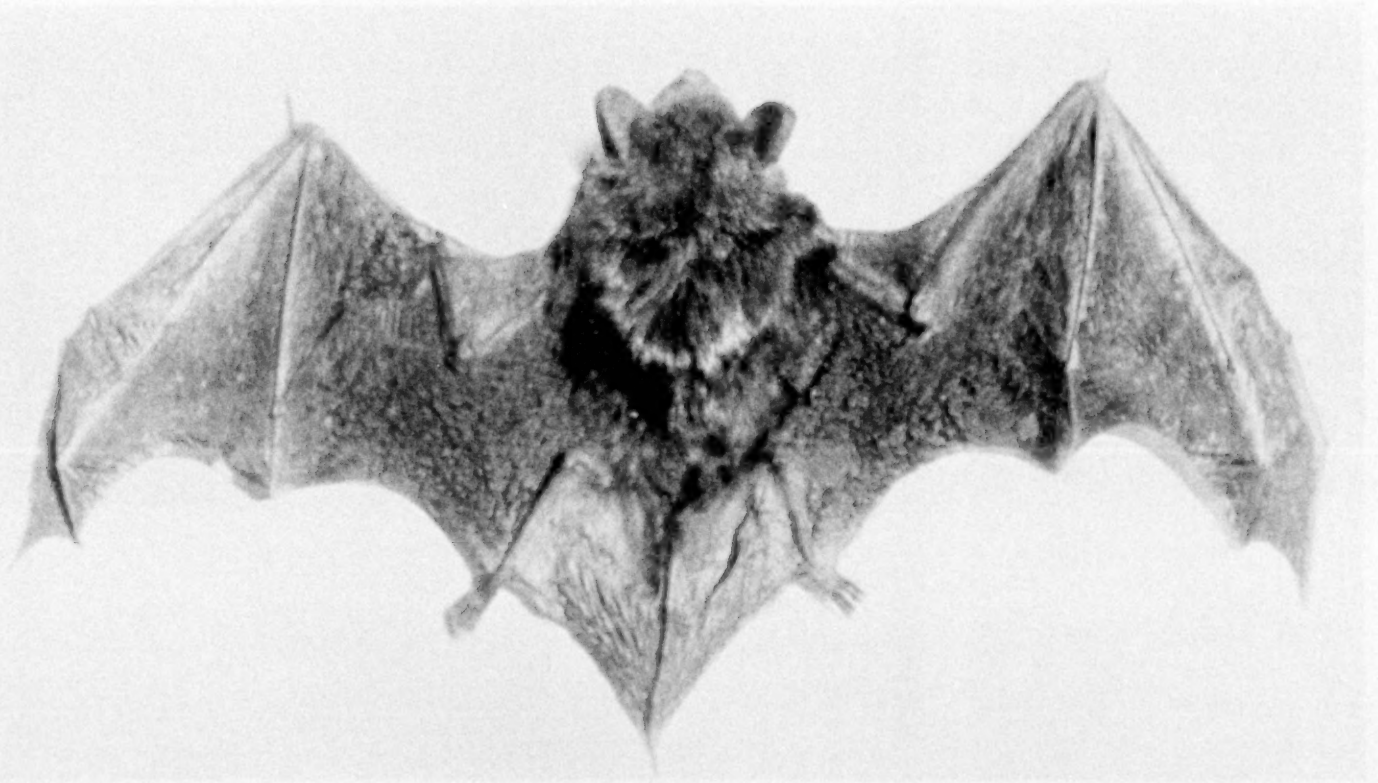
THE BATS HANG IN VAST COLONIES FROM CEILINGS OF CAVERN

With but one young a year, it would seem that bats must live long to keep up their normal abundance, but there appear to be no available data as to their longevity or as to what becomes of them when their life cycle is closed. Generally they have few enemies, and their abundance is probably limited only by the normal food supply.

The bats of the Carlsbad Cavern are mainly the Mexican Free-tailed, *Tadarida mexicana*, the famous guano-producing species of Mexico and the southern United States. Their habits of roosting in enormous colonies in caves or buildings has given them a special value in the production of great quantities of guano, a product much prized as a fertilizer.

They differ from most of our northern bats in the projecting tail, which reaches about an inch beyond the attached membrane; in short, wide ears, short, close fur, and a strong, musky odor peculiar to the species. They are not the only species of bat in the great cavern, but are so numerous that the others are little noticed (see illustrations, pages 325 and 327).

Their numbers vary at different seasons, apparently reaching the maximum in late summer and early fall, when they gather for the winter's sleep, and the minimum about the first of May, when



Photograph by Vernon Bailey

THE FRINGED BAT (SEE TEXT, PAGE 330)

This is one of the Small-eared Bats, *Myotis thysanodes*, widely distributed over the southwestern United States and Mexico, and a regular inhabitant of caves.

many have left for lower country and better feeding ground.

On a warm evening in early May, about 10,000 came out of the cave—their numbers partly counted and partly estimated. From descriptions of the dense cloud of bats coming out in August, the numbers must run into hundreds of thousands, if not to millions, and such estimates would be necessary to account for the great deposits of guano taken out of the cave.

The conditions of temperature, moisture, and space in this great cave seem to suit the bats better than those in any other of the numerous smaller and drier caves of the region. The enormous rooms in which they cling for their winter sleep to the ceiling 150 feet above the floor are very uniform in temperature, varying only from 55 to 60 degrees Fahrenheit, from early March with its freezing weather to hot days of May, and is said to show no noticeable difference in temperature throughout the year.

The air of the cave is moist and heavy with the musky odor of bats, an odor that with a favorable wind can be detected outside half a mile from the entrance. To the bats this odor may be recognizable at a much greater distance and serve a very useful purpose in bringing them back from their nightly wanderings and from their seasonal migrations.

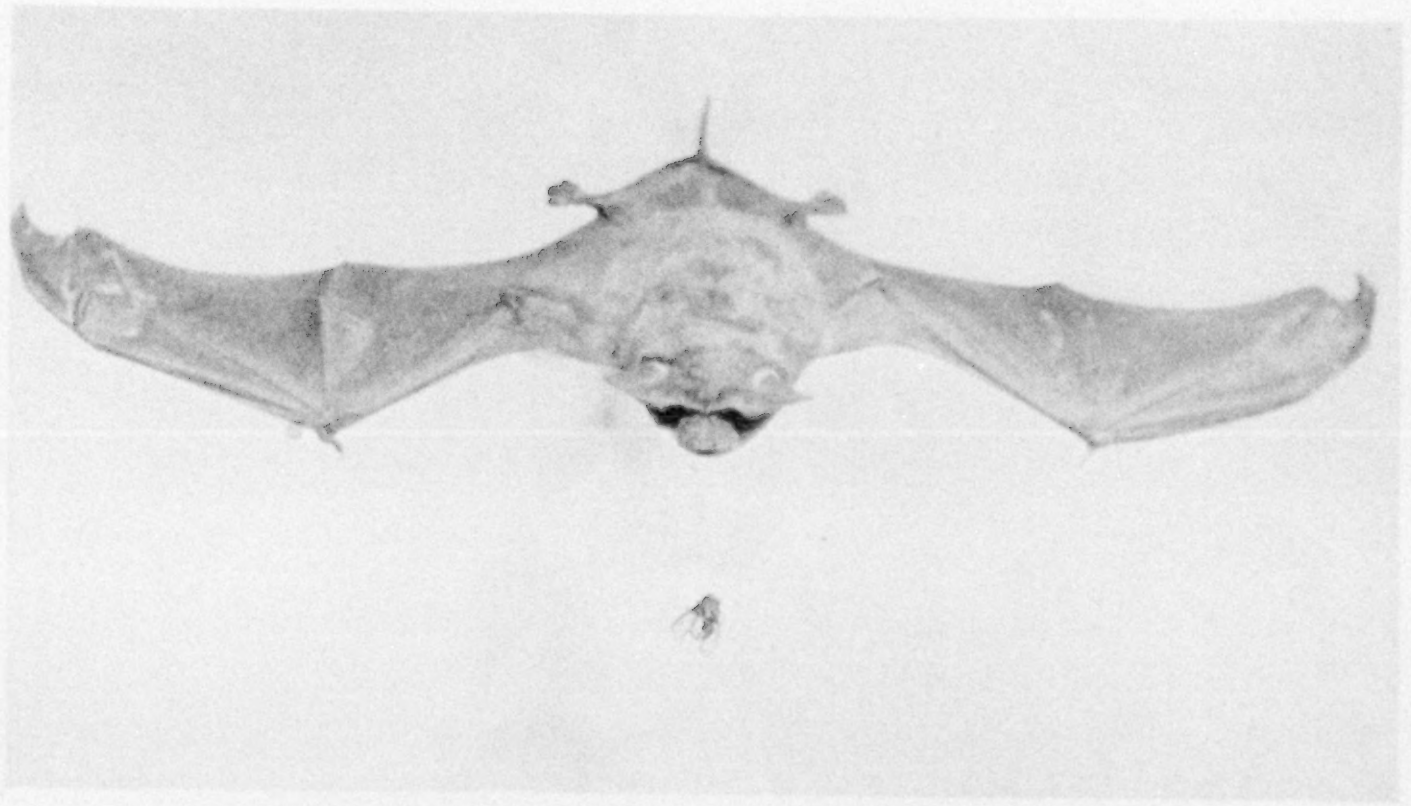
GUANO DEPOSITS COLLECTED DURING THOUSANDS OF YEARS

The guano deposits, composed entirely of insect remains, reach back into geologic ages, lying under huge stalagmites that have been thousands of years in forming.

When first brought to commercial notice, in 1901, the guano filled some of the largest rooms to a depth of 100 feet, coming up nearly to the natural openings and sloping away for hundreds of yards over the cave floor. From all records now available, the estimates of 100,000 tons of guano taken out of the cave seem not too high. Most of this has been shipped to the California Fertilizer Company at San Bernardino, California, and sold at prices ranging from $20 to $75 a ton.

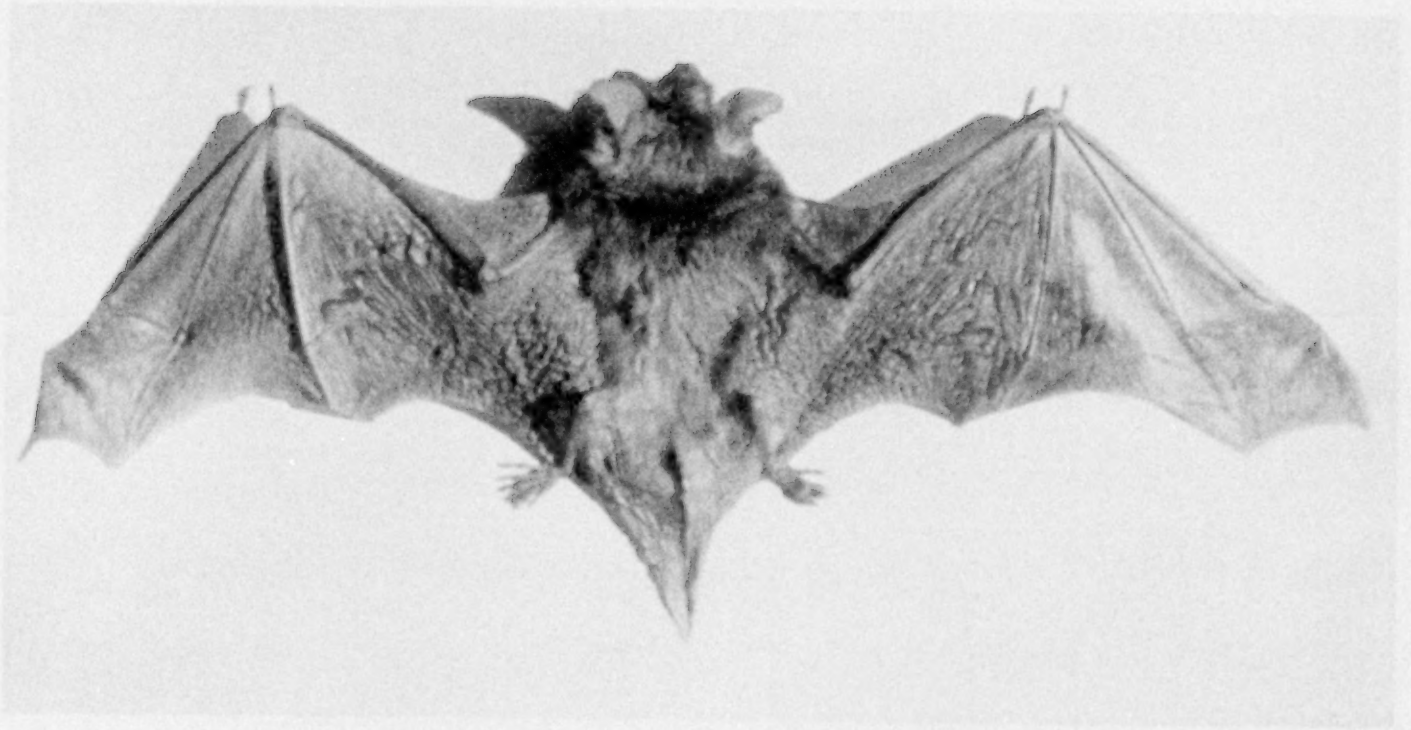
The guano remaining in the cave would make but a few carloads, and most of it is old, mixed with earth, and of low grade as a fertilizer.

A special effort was made to determine the rate of deposit of the guano, but with little satisfaction, because of the cold weather of March and April, the conse-



ON THE WING, THE GUANO BATS ARE STRONG AND SKILLFUL FLIERS (THIS SPECIMEN AND ITS QUARRY HAVE BEEN POSED BY THE PHOTOGRAPHER)

They hunt their insect food at night, capturing and devouring beetles, moths, flies, and a host of winged insects of nocturnal habits. The guano deposited under their roosts in the caves is composed entirely of insect remains. How many insects would be required to make 100,000 tons of guano? (See text, page 324.)



Photographs by Vernon Bailey

THE LARGE BROWN BAT, ABOUT TWO-THIRDS NATURAL SIZE

This is the commonest bat in Slaughter Canyon, near the Carlsbad Cavern, where great numbers come to drink at the water tank in the evening. In summer this bat lives mainly in the northern, forested regions of the continent, but in winter it is probable that it seeks more comfortable quarters in the south (see text, page 329). Note how the knees of a bat bend backward.

Photograph by Vernon Bailey

A MOTHER RED BAT AND HER FAMILY OF FOUR YOUNG

This mother bat was brought into the National Museum just as she was found hanging to a twig in a maple tree. Each of her four young was clinging to a nipple with its mouth and to the mother's fur with its twelve hooked claws. The four young weighed 12.7 grams, while the mother weighed only 11 grams, so they were a little more than a quarter grown. They showed no inclination to let go, and it must be inferred that the mother carries them while flying in pursuit of insect prey until they are old enough to hang up in the tree and wait for her return, or to fly and catch their own food (see text, page 330).

quent inactivity of the bats, and the resulting slight deposits of guano.

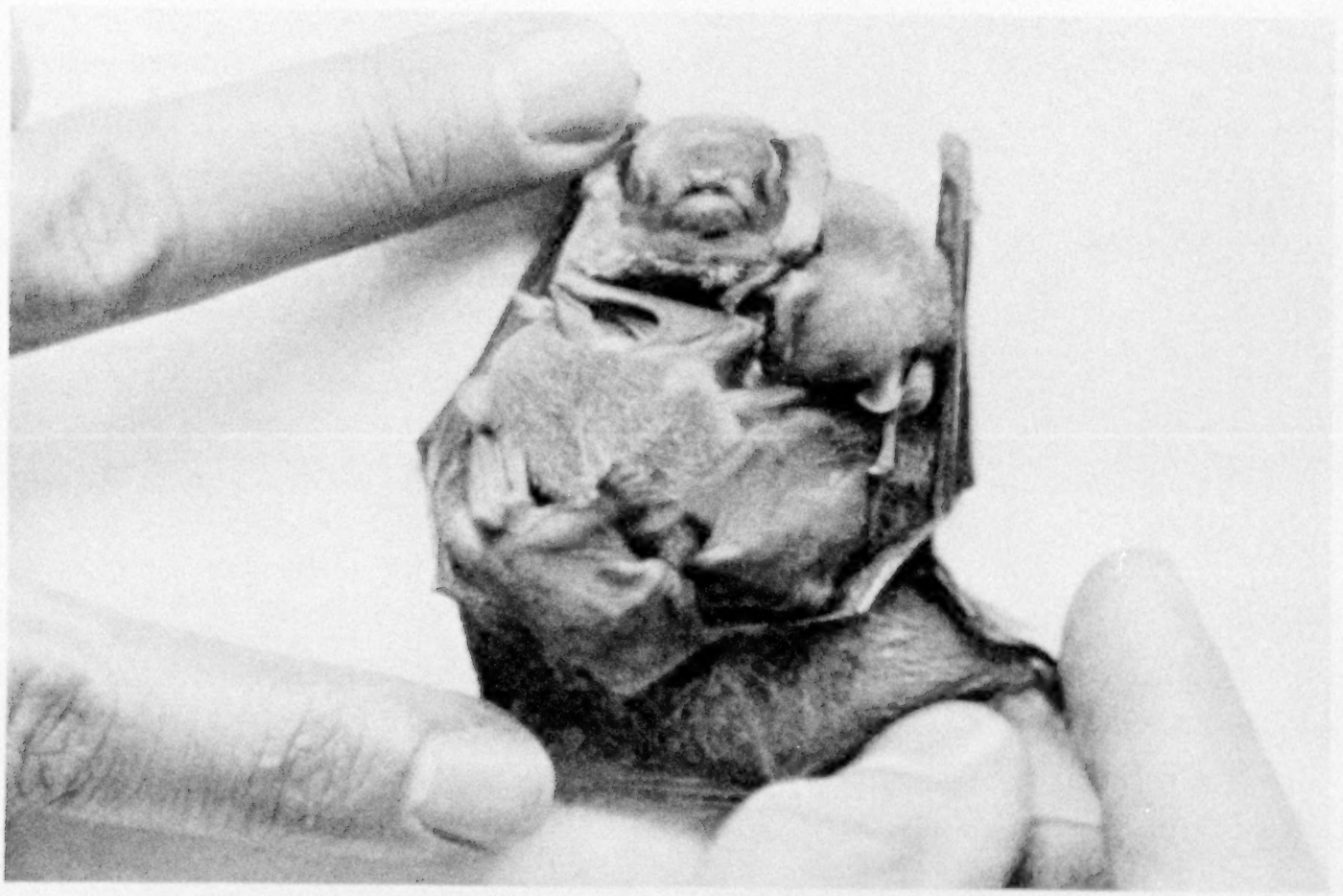
I could not catch sufficient insects to satisfy the appetites of my captive bats, and thus test the rate of deposit. The bats evidently could not catch enough insects during the cool nights to fill their stomachs, which on the return to the cave in the early morning were not more than half full. Stomachs of bats coming out in the evening usually were empty.

Under the densest part of the bat colony, on April 29, a paper 20 by 30 inches was spread to catch the droppings. In 44 hours it caught 1,145 pellets, which weighed at first 5 grams and when air-dried 3.7 grams. These did not more than half cover the surface of the paper, so that a single layer of droppings about 2 millimeters thick would have required over 2,000 pellets and about 4 days of time.

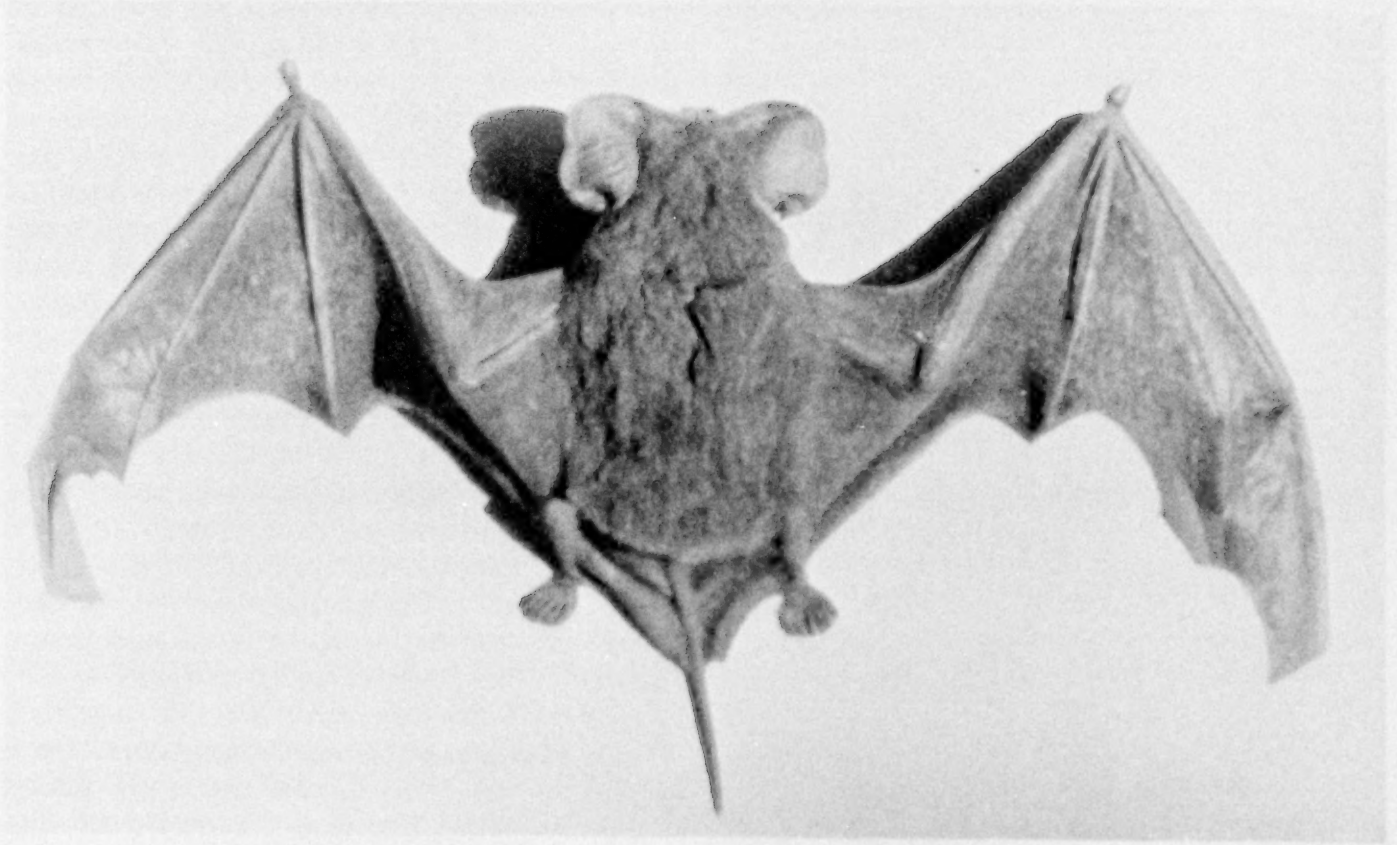
The fact that in the three years since any guano has been removed from the cave there have accumulated no deposits more than three inches in depth would indicate a very slow rate of deposit, even where the bats are very numerous.

One inch a year of fresh pellets would certainly shrink to half an inch when disintegrated to dust and packed and settled into the solid mass of the old, deep guano, rich in nitrogen, phosphoric acid, potash, and other valuable elements of plant growth. Even under a large colony of bats, it would seem that 50 feet of guano might well represent the food refuse of more than 1,000 years.

But for most of the bat colony this cave is a winter resort rather than a summer home. In other caves farther south, where the bats live both summer and winter, the rate of deposit is much more rapid. In a smaller cave near San Antonio, Texas, about 60 tons of bat guano have been taken out annually for 29 con-



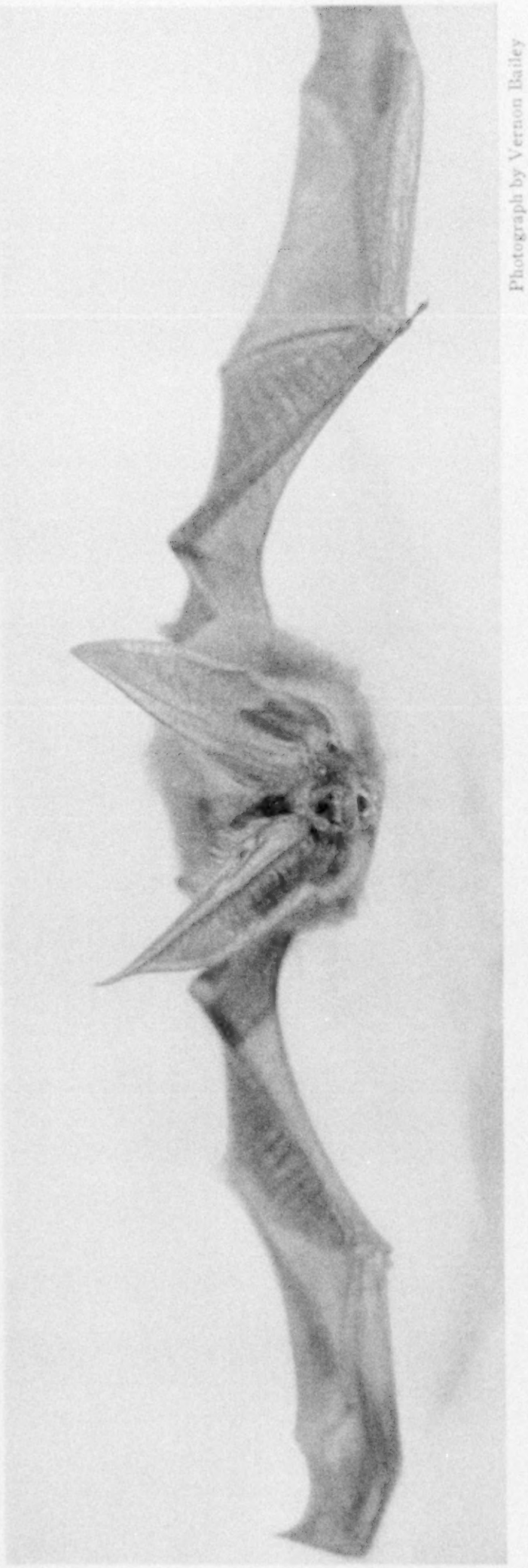
PHOTOGRAPH OF A MOTHER RED BAT WITH WINGS AND TAIL HELD BACK TO SHOW THE FOUR YOUNG CLINGING TO HER BODY (SEE, ALSO, OPPOSITE PAGE)



Photographs by Vernon Bailey

THE FREE-TAILED OR GUANO BAT

These bats belong to a mainly tropical family reaching into the southern United States, and are very different from our northern species in structure, habit, and odor. The tail projects about an inch beyond the attached membranes, the ears are short and wide, the fur close and oily. They have a strong, musky odor and are more extensively colonial than are any other of our North American bats.



Photograph by Vernon Bailey

THE LONG-EARED BAT, SOMETIMES CALLED THE JACKASS BAT, OR JACK RABBIT BAT

These bats are cave dwellers, but never in great numbers. A dozen or a hundred or a few hundred are sometimes found together in a cave, or in summer in an old building.

secutive years, and other caves have yielded comparable amounts.

A good productive bat cave has the advantage over a gold mine in being self-perpetuating.

But the real value of the bats lies in their enormous destruction of insect pests, which is well illustrated by a permanent yield of 60 tons a year of insect shells in one locality.

THE LONG-EARED BAT STUDIED DURING HIBERNATION

Besides the vast numbers of Free-tailed, or Guano, Bats, which hang close together under the roof of the highest room in Carlsbad Cavern and by their rank odor apparently keep other bats at a distance, there are about a dozen species that occupy, or have occupied, various parts of the cave or near-by caves and canyons. Of the 18 species of bats known in New Mexico, 13 have been found in this vicinity.

In the farthest, deepest room of the cave, where there were no living bats, numerous skeletons were found lying on the dusty floor. They were usually old and bleached, but some were dried mummies that may have been there for many years. Most of these were of the Guano Bats, but they included also bones of many other species.

The Long-eared Bats, *Corynorhinus rafinesquii pallescens*, one of the most interesting and spectacular species of the region, were found in considerable numbers in McKitterick Cave, some 20 miles farther north. On April 15, when first discovered, they were still in profound winter sleep, hanging head down from the low limestone ceiling and on the rock walls of the cool, dry rooms, their great ears rolled up in spiral coils like rams' horns on each side of the head.

Their bodies were cold and apparently lifeless, their respiration and circulation reduced to the minimum, and all the bodily functions greatly retarded. Unfortunately, I had no thermometer with me, but the temperature of the rooms was apparently about 60 degrees Fahrenheit and the bodily temperature of the bats approximately the same.

Here the bats had hung all winter, nourished by their store of fat and bodily fluids and still in good condition. When brought out into the warm air they soon uncoiled their ears, stretched their wings and legs, and when handled opened their little red mouths and squeaked protestingly. Some which were kept for several days in a cloth bag hung up in my room were warm and active during the daytime, but when the temperature dropped below 60 degrees, as it usually did at night, they rolled up their ears, became cold and torpid again, and in the morning were in a state of hibernation (see page 322).

The Large Pale Bats, *Antrozous pallidus*, are common bats of the region, but none was found alive near the cave, or nearer than Carlsbad, 26 miles distant. In summer they are generally found living in houses, barns, cliffs, and small, dry caves, but little is known of their winter resorts.

In Slaughter Canyon, about 15 miles west of Carlsbad Cavern, dozens of their decaying bodies were found in an iron water tank at the goat ranch, where they had fallen in while drinking and had drowned. The tank was about 20 feet across and only 5 feet deep, but these large bats evidently could not drink from the surface of the water so quickly as to be able to rise again before striking the sides. No smaller bats were found in the tank, although many came to drink.

A number of bat skulls or jaws were found among the owl pellets on the floor of the Bighorn Cave, in the west branch of Slaughter Canyon, where they may have been roosting, or may have been brought in by the Great Horned Owls which nest in the cave.

The Large Brown Bats, *Eptesicus fuscus*, were represented in the Carlsbad Cavern by an old skull and wing bones found on the floor of the deepest room, where they had lain for many years.

Among the numerous bats seen outside, flying about at night, they may have been common, but only in Slaughter Canyon were any specimens taken. Here they were apparently the commonest bat, coming in by dozens to drink at the water tank in the evening and approaching from the direction of the large, open Slaughter Cave near there (see page 325).

In summer these bats are found mainly in the higher, timbered zones in the mountains, from New Mexico to Canada, and across the middle part of the continent, where they are an abundant species, especially in the forested regions. It seems probable that they come down to this level to find comfortable winter quarters, either in the caves or far back in cracks and crevices of the canyon walls.

SILVERY-HAIRED BATS BREED IN CANADA

At Oak Spring, from which we obtained water for camp use while working in the cave, one of the Silvery-haired Bats, *Lasionycteris noctivagans*, was obtained by Dana Lee as it came in to water, on the evening of April 12, and a few days later a couple of others were seen in Walnut Canyon, near there. Their very black color throughout renders them conspicuously different from other bats when they first begin to fly, in the early twilight, for the silvery frosting on the back does not show while they are on the wing.

They are northern bats of migratory habits, breeding mainly in the Canadian Zone of the mountains or far north, and moving, at least in part, to lower levels or lower latitudes for the winter. There are few records of their occurrence in New Mexico, but some of the caves of this region may afford just the right degrees of temperature and humidity required for their winter sleep.

Any cave that offers winter quarters for these defenders of our northern forests should be given special protection.

The House Bat, *Myotis incautus*, was represented in the lowest room of the great cave by several fragments of old skulls which may have been there for many years, but in another cave near Carlsbad about 1,000 of these bats were hanging to the low roof within easy reach of my hand. They were readily photographed in a very lively moving picture,

as they broke away from the solid mass in which they had been huddled together.

One of the Fringed Bats, *Myotis thysanodes*, was found in a rain barrel close to the open ladder shaft of Carlsbad Cavern. It is largely a cave-dwelling species, and this one may have come out of the shaft and, in attempting to drink from the water in the barrel, have fallen in and drowned (see page 324).

The Cave Bat, *Myotis velifer*, and the Little California Bat, *Myotis californicus*, have a general distribution over this region, but the only specimens taken at the cave were skulls picked up in the big dry room at the farthest end and lowest level. These remains and the traces of guano in this chamber are so old as to suggest a former entrance now closed or hidden.

The tiny Canyon Bat, *Pipistrellus hesperus*, easily recognized by its small size, whitish fur, and very black wings and ears, was often seen early in the warm evenings, flitting about in the big western doorway of Carlsbad Cavern, where it probably lived in the cracks and small openings of the cliff, rather than down in the dark chambers. It was also the most abundant bat along the canyon walls and at Oak Spring, just over the ridge, where hundreds came to drink every evening. Its very small size would suggest quite a different set of food insects from those eaten by the larger bats.

A jawbone of this little bat picked up with other bones from owl pellets under the nests of Great Horned Owls in the Bighorn Cave, in Slaughter Canyon, does not necessarily mean that they live or winter there, although this is probable.

The Great Hoary Bats, *Nycteris cinerea*, largest of our northern bats and conspicuous by their short ears and silvery-gray fur, are not common in New Mexico and occur mainly as migrants from their northern or mountain homes to southern winter grounds. They have been found as far south as Brownsville, Texas, and southern California, but where or how they spend the winter has never been known.

In summer this species is generally found during the day hanging head downward in some dense foliage of trees or bushes and, so far as we know, is not given to entering caves or buildings. Wing bones of several individuals were found on the floor of the deepest, farthest room of the cave, which would suggest this as a wintering place for the species.

Jim White, for many years in charge of the guano mining operations of the Carlsbad Cavern, told me of finding a very large gray bat hanging in the leaves of a walnut bush in the canyon below the cave and making a fierce little noise like a miniature cat fight. This could have been no other than the Hoary Bat.

A MARVELOUS EXHIBITION OF POWER OF FLIGHT

The Red Bat, *Nycteris borealis*, has never before been recorded from New Mexico, but the southern part of the State is well within its range. Two old skulls found among other bat remains on the floor of the farthest, deepest room of the cave would suggest that this chamber farthest away from the colony of Guano Bats was used as a wintering ground by the Red Bat as well as by several other species. While mainly tree bats, hanging during the day in the leaves of trees or bushes, they are known also to enter caves and may seek such quarters for winter hibernation.

Unlike most bats, the females have four mammæ, and two to four young have been found clinging to their mother, their combined weight considerably exceeding hers (see pages 326-327).

These mothers were found hanging in trees and were not actually observed in flight with their burdens of young; but the inference is that they must carry the young about with them in pursuit of their regular prey, flying insects captured in the air. Where is there another example of such power of flight by bird or beast?

Early reports that the bats were the only animal life in the Carlsbad Cavern have been disproved by the discovery of several other mammals and two cave crickets occupying its whole extent, while a number of insects, spiders, and a myriapod occupy the first large rooms, where there is still a trace of reflected light.

Many other mammals and some birds live in the gloomy halls of the entrance shafts, either permanently or temporarily, and still more in the immediate vicinity outside.

EXPERIENCES OF A LONE GEOGRAPHER

An American Agricultural Explorer Makes His Way Through Brigand-infested Central China en Route to the Amne Machin Range, Tibet

By Joseph F. Rock*

Author of "The Land of the Yellow Lama," "Banishing the Devil of Disease Among the Nashi," and "Hunting the Chaulmoogra Tree," in the National Geographic Magazine

MUCH of a most unpleasant nature has happened to me in recent months. I was delayed about one month in Yünnanfu on account of my Nashi assistants, who were held up by brigands between Talifu and the capital (see map, page 334).

Between Yünnanfu and Tungchwan, in east Yünnan, we met brigands twice and had some real scares. A number of the people who followed in my train for the sake of protection lost some of their belongings and two loiterers were captured.

From Tungchwan to Chaotung is five days' journey north and just two days out of Tungchwan I had the most terrible experience of my life. I had been informed that there were about 1,000 brigands between the two places, and that the road was practically closed. The magistrate of Tungchwan assured me, however, that all the brigands were in the Chaotung district. He said he would send 20 soldiers with me, and that I had nothing to fear in his district, at any rate.

I was informed by various other parties that if I once reached the Chaotung district I was safe, and that all the brigands were in the mountains near Yichehsün, two or three stages from Tungchwan.

I saw the mandarin several times, and he finally admitted he had only 60 soldiers in the town, and that the rest, 120 of them, were fighting brigands near Lütien, not far from Chaotung. He agreed to give me 40 soldiers and again protested that there were no robbers in his district.

I sent a dispatch to the American consul at Yünnanfu, asking him to get the advice of the governor, but as the wires between Tungchwan and the capital had been cut by the brigands the message had to be forwarded through Kweichow Province, which took more than two days.

I sent word to the magistrate of Chaotung to have soldiers meet me at Yichehsün, but he agreed to order them only to the border of his jurisdiction.

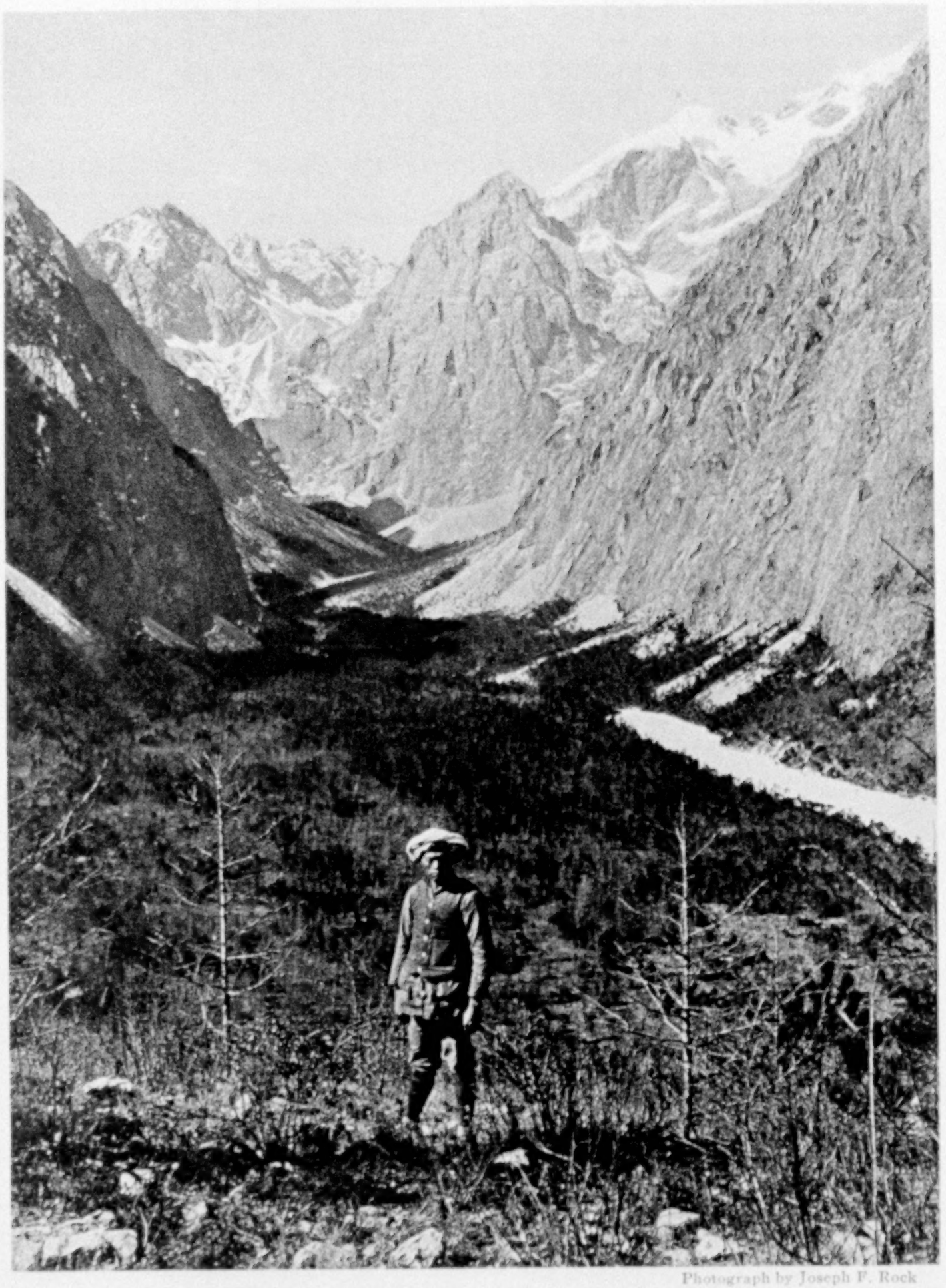
BRIGANDS ATTACK FROM THE REAR

With much misgiving I left Tungchwan. The first day passed without incident, but the second had much in store for us. After lunch under an old walnut tree, I made my way over the mountains with my 12 Nashi men, 26 mules, 40 soldiers, and all the followers who took advantage of the protection afforded by my guard.

We had not gone very far when my head muleteer reported that robbers were behind the caravan. I waited for the mules to catch up with us, and as they came in sight I rode on, but not for long, as my boys yelled in Chinese, "Robbers are coming," and at that moment the bandits began to shoot.

My soldiers behaved admirably, climbing to the ridge and opening fire on the brigands, but we soon found that we were considerably outnumbered. We pushed on as best we could over a pine-covered slope, down a deep ravine and up the other side, along a terribly rocky trail, the soldiers covering our retreat under the fire of the brigands.

*This informal narrative of experiences in the Far East has arrived as a letter written from Choni, Kansu Province of China, near the northeast border of Tibet, on May 17, a few days before the author set out upon his hazardous journey into the fastnesses of the Amne Machin Range. Dr. Rock, who was the leader of the National Geographic Society's expedition to Yünnan Province (see the National Geographic Magazine for April, 1925), is now collecting plants for the Arnold Arboretum of Massachusetts. He does not expect to return to America until the latter part of 1928.—The Editor.



Photograph by Joseph F. Rock

THE AUTHOR'S NASHI PHOTOGRAPHIC ASSISTANT

The stream bed visible in this picture (Yünnan Province) is ordinarily dry, except during heavy downpours in the summer months, the water usually disappearing underground. The rocks in the stream bed are pure white limestone.

The shooting continued all afternoon, but, thanks to the bad marksmanship of the brigands, we lost only one soldier killed.

When we finally reached the small plain of Yichehsün, on the edge of which is the hamlet of Panpiengai, I thought we were safe. But the brigands followed us. They looted the little place, capturing three soldiers and their guns.

We eventually reached the village of Yichehsün, where we had to stop for the night.

Just as I arrived and passed through the dilapidated old gate (but no wall) there also came up 35 soldiers from Chaotung. They had first gone to Kiangti, but, as I had not appeared, they pushed on to Yichehsün. As I was talking with their officer, one of the Tungchwan soldiers came running into the village to tell me that a band of 200 robbers was only a mile and a half away.

The Chaotung soldiers went to help the Tungchwan soldiers, but soon all returned with the robbers at their heels.

THE FLAG WHICH PROTECTED THE AUTHOR FROM MOLESTATION BY ONE GROUP OF BANDITS

This triangular bit of yellow cloth, on which Chinese characters are painted in alternate red and black, was presented by a brigand chief to Joseph F. Rock, who displayed it with excellent results from his tent pole while camped in a bandit-infested region in Yünnan Province. The legend reads: "Commander's flag; Temporary Station, American Agriculture, Forestry Department, Special Explorer." Unfortunately, Dr. Rock did not have this talisman on the journey which he describes here.

CAMP IS ESTABLISHED IN COFFIN-FILLED TEMPLE

I was quartered in the center of the village in a miserable old temple full of coffins. The brigands came to within a half mile of the hamlet, where stood a large temple, and of this they took possession.

Darkness came on. At midnight the officers of the soldiers came in and announced that the brigands were outside and that the town could not be held against the impending attack. I never spent such a night in all my life.

I opened my trunks and distributed $600 in silver among my men, wrapped up some extra warm underwear, a towel, condensed milk and some chocolate, besides ammunition for my two .45-caliber revolvers.

Fully clad, I sat waiting for the turn of events. Every minute we expected the firing to commence. The soldiers said that they could protect me, but not my boxes, and that the safest move would be to retreat and try to find a hiding place if the brigands rushed the temple.

The natives of the village began burying their few valuables and great excitement ruled. It was a terrible wait and the longest of nights. Outside the hamlet heads of brigands that had been captured some days before were hanging from poles.

I was informed that several hundred bandits were surrounding the village and that capture was inevitable. At 4 a. m.

Drawn by C. E. Riddiford

A SKETCH MAP OF THE AUTHOR'S ROUTE

The trip described by Dr. Rock began at Tungchwan, north of Yünnanfu, and bore northward to Choni, from which base the explorer hopes to encircle the main peaks of the Amne Machin Range. He expects to return to Taochow in November or December.

our besiegers were still outside but no shot had been fired. At dawn there was not a bandit to be seen! They had vanished.

The people of Yichehsün begged me not to leave, saying that if I departed with the soldiers the robbers would come and burn the village the next night. I replied that I could not remain indefinitely, and that my presence was only an incentive for an attack. We had come to the conclusion that the people of Yichehsün intended to turn me and my caravan over to the brigands as a sort of peace offering on condition that the latter would leave the village alone.

As day broke the order to proceed was given.

The people said, "Oh, the bandits went ahead to a terrible mountain pass called Yakoutang and there they will intercept you!"

This I had feared myself, but, save for a rear attack by a band of robbers on that day's march, we reached Chaotung without further molestation.

The mandarin of Chaotung, in the meantime, having heard that I was surrounded by brigands, had immediately dispatched 250 soldiers to the rescue. They came too late to be of assistance; we met them one day out of Chaotung.

WOLVES RAID A GRAVE AT THE AUTHOR'S DOOR

In Chaotung I was ill, and also delayed by blizzards which lasted 11 days and made travel impossible.

I camped in an ancient temple outside the city walls. It was a lonely place, my only neighbors being the occupants of a few graves just beyond the temple walls. It was bitterly cold and I had to pitch my tent in the one long room in the temple proper among the idols; the roof was defective and the snow came through. It was, indeed, a miserable place. Charcoal was impossible to get, as the people from the outlying villages did not come in, owing to the heavy snow.

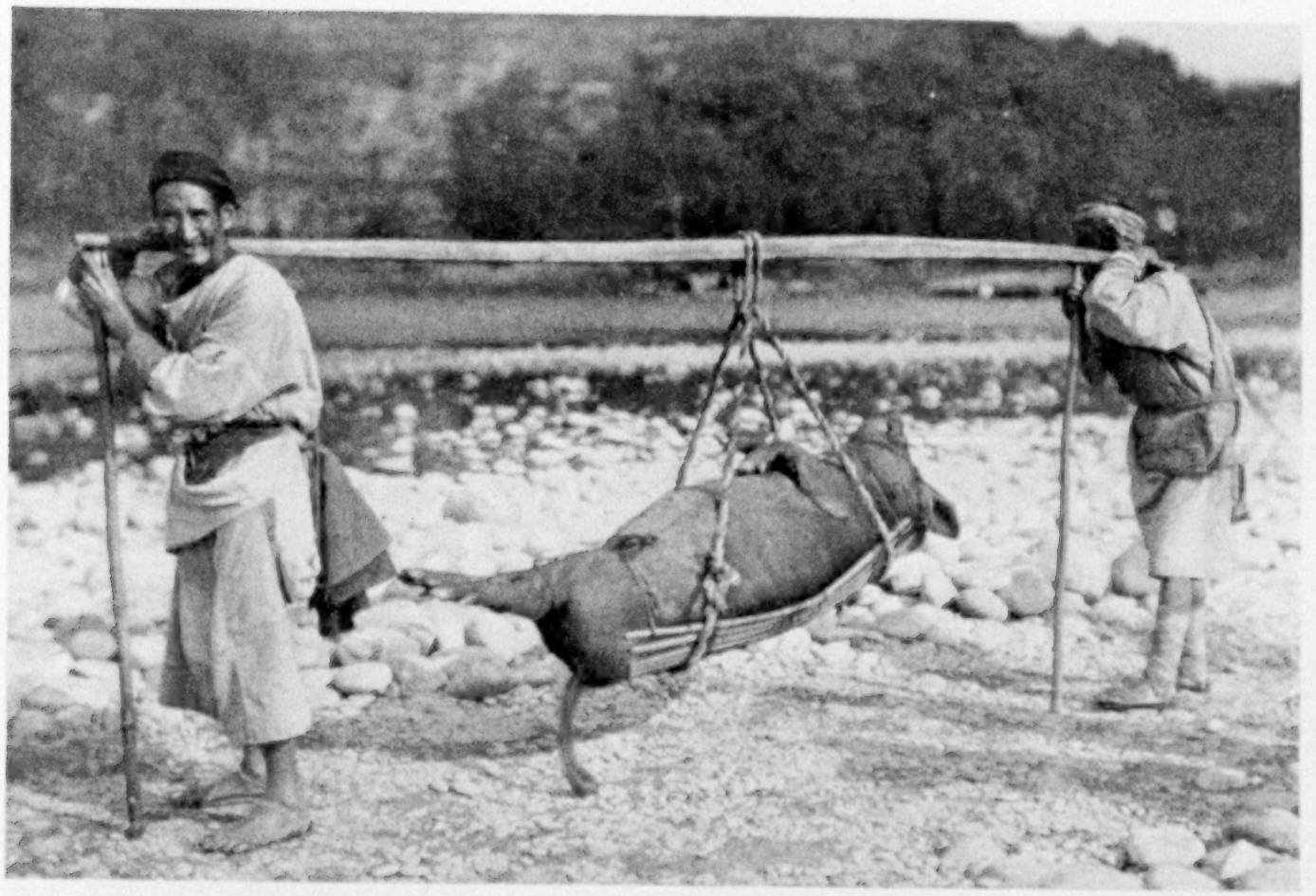
A few days before my arrival a burial had taken place near my temple, and there was a new grave just beyond the wall. One moonlight night wolves came to the temple door and howled for hours. I was afraid that they might jump over the low walls and attack us, but they contented themselves with digging up the newly buried man and devouring him. All we found the next morning were a few blue rags and the open coffin.

I was glad to resume my journey.

For days we waded through snow, and the mules had great difficulty going over narrow, icy trails which led through terrific canyons.

BRIGAND CHIEF PROVES TO BE IDEAL ESCORT

I had a peculiar military escort from Chaotung on. My soldiers were former bandits, whose chief, a famous brigand, had accepted employment with the Yünnan Government and undertook to escort parties through territory infested by robbers



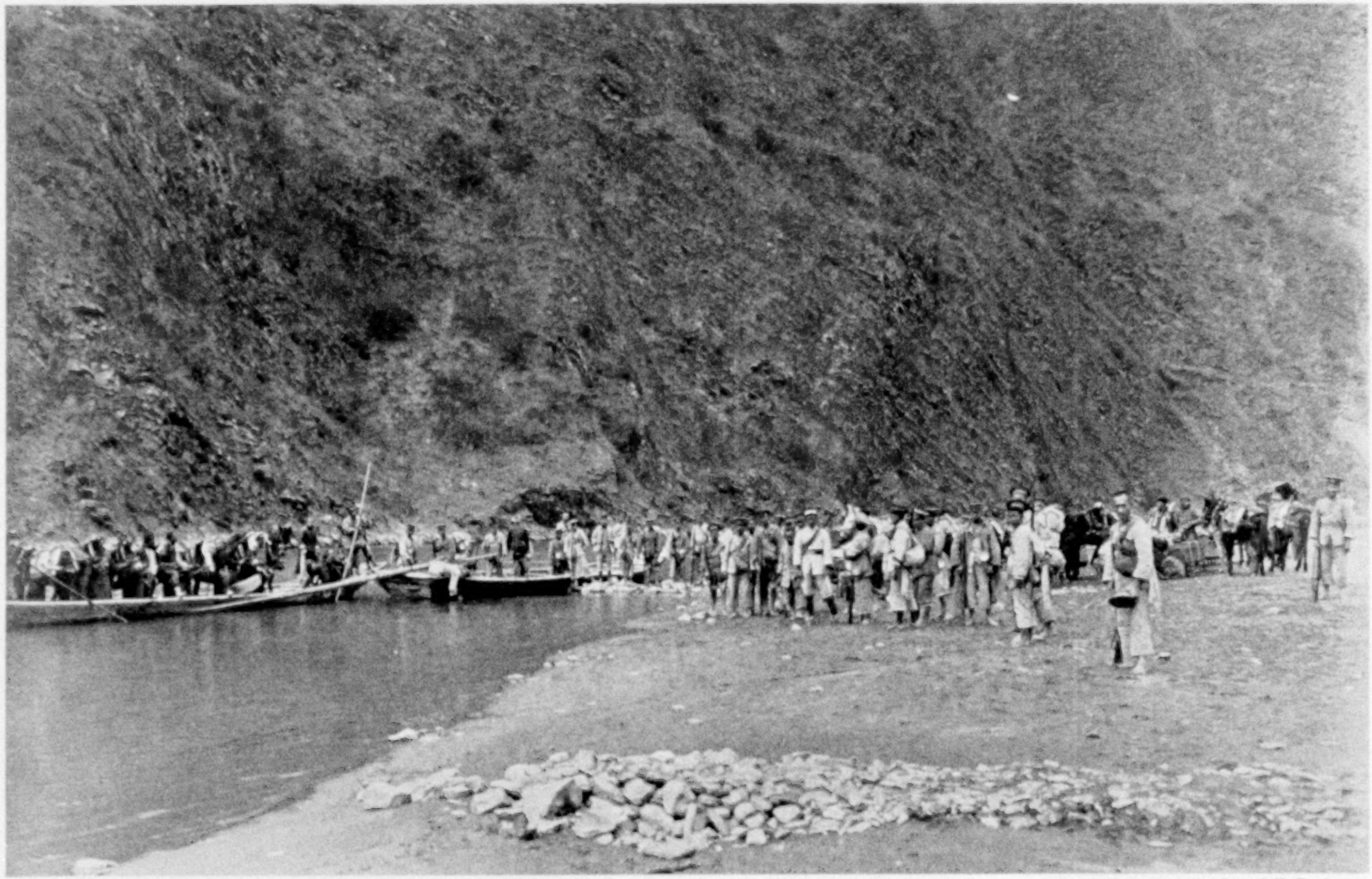
THIS LITTLE PIG WENT TO MARKET: KIATING

Two men have carried it for many weary miles and, as the burden weighs 275 pounds, they are forced to stop and rest every 100 yards. They cannot put their load down, for it will scramble to its feet and run away; so they provide themselves with stout poles on which to rest it and themselves as well.

Photographs by Rev. Archibald G. Adams

A CHINESE MOLASSES-CANDY PULL: SZECHWAN

An assistant stands ready to catch the candy if it should fall while being draped over the hook.



Photograph by Joseph F. Rock

A PORTION OF THE AUTHOR'S CARAVAN AND SOLDIERS CROSSING THE FUKIANG RIVER IN NORTH SZECHWAN

Only half of the caravan and escort is visible in the photograph.

who were formerly members of his gang. Anyone accompanied by his men could rest assured that no one would attack him.

Often I was told: "To-day there are robbers on the road." Sometimes it was a band of as many as 80 bandits well armed, but my escort would say, "We will go ahead and arrange things with the robbers and then we will escort you through their district and you will have nothing to fear."

Thus I reached the Ta Kwan River, a tributary of the Yangtze, above Suifu. Here I chartered a boat, which brought us safely to Suifu. From there I went to Kiating and by river to Chengtu, the capital of Szechwan.

In Chengtu I was delayed by fighting to the north and also on account of illness. Governor Yang of Chengtu took the city of Mienchow five days north of the capital and drove out an independent general with 10,000 troops. The latter and his soldiers looted the city before they left, and the incoming soldiers of Governor Yang looted what remained. They even attacked the mission, and a missionary family—a Mr. Willistan and his wife and boy—was captured by bandits only 40 li (16 miles) from Mienchow. Traveling was very unsafe, as the defeated soldiers scattered into bands and turned highway robbers.

CAVALCADE IS A HALF MILE LONG

I left Chengtu with an escort of 140 regular soldiers and some cavalry. As we neared Mienchow the guard was increased to 190 soldiers, who marched with loaded rifles and fixed bayonets. Often, when I looked back from a hill, my train was over half a mile long, with a caravan of 26 mules, my helpers, 17 muleteers, and the soldiers. We were quite a formidable party (see illustration, page 336).

Many people joined my train for protection. However, in spite of my strong escort, we had to take a narrow and tortuous trail over mountains little frequented by travelers, as the main road to Mienchow was closed by a small army of brigands. Even the military did not dare take the shorter main road.

My escort was changed from town to town, and, as some of the places, like Hanchow, Tehyang, and Lokiang, were "on the fence," so to speak, my soldiers from one community were not permitted to enter the next, for fear that they might fight and loot. Each group from the preceding town had to turn back at the city gates. Soldiers of the city at which we were arriving usually waited for me outside the gates and escorted me in.

We passed many dead soldiers on the road. Sometimes only the trunk was left, the head, hands, and feet having been chopped off. We also met many half-dead stragglers, who sooner or later joined their dead companions stark on the road.

IN THE GREATEST MEDICINE MARKET OF CHINA

From Mienchow I went to Chungpa, the greatest medicine mart of Szechwan, if not of all China. Here I found the Szechwan-Kansu border troops. Governor Yang had sent instructions that they see me safely to Pikow, the first large village in south Kansu.

The officer in charge of the border troops was very timid. He said he could escort me only as far as the Szechwan line, for last year the Kansu border troops and his men were fighting. Many villages were burned, and he was afraid that if his soldiers went to Pikow with me they would be disarmed by the Kansu soldiers and killed. I replied that as long as they were with me the soldiers would have nothing to fear, but he answered, "Yes; as long as we are with you, the Kansu troops will not dare do anything to us, but when we return alone, they will attack us."

A ROYAL RECEPTION IN KANSU PROVINCE

We went on to Chingchwan, the last town in Szechwan, and from there I sent a runner to Pikow with a letter to the officer in charge of the south Kansu border troops, asking him to give me an escort to Motzaping, the first village in Kansu, to which point the Szechwan troops were to accompany me.

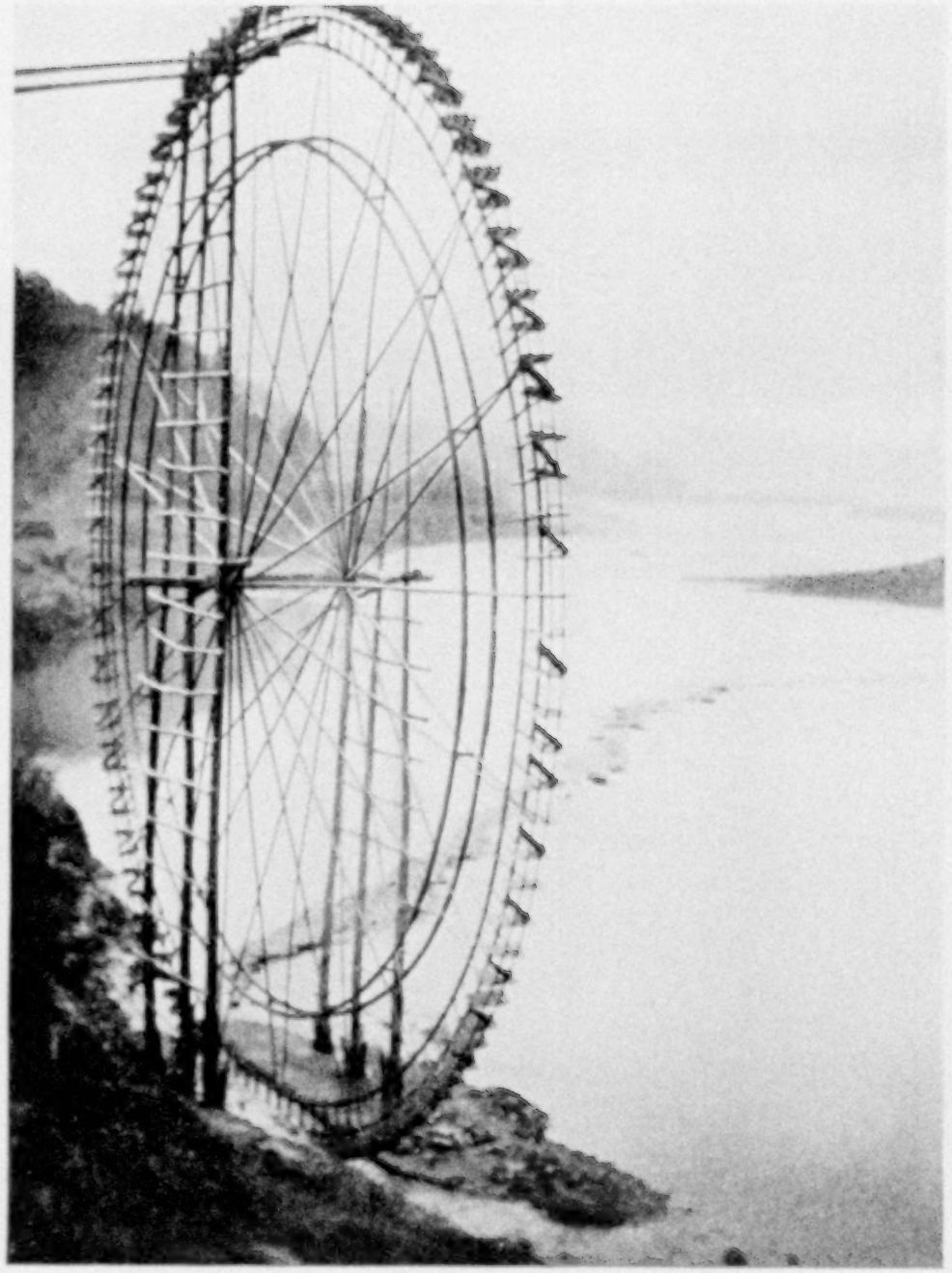
Near the Szechwan border a few Kansu soldiers brought me the cards of two officers, who were waiting for me at Motzaping.

All was very amiable when the enemies met, the Szechwan soldiers and their officer turning me over to the Kansu

Photograph by S. R. Vinton

A BOAT SCENE NEAR CHENGTU, CAPITAL OF SZECHWAN PROVINCE

Chengtu, with a population of 400,000, is situated in the midst of a plain which is considered one of the "most highly productive and most thickly populated areas of its size on the surface of the globe." (See, also, "The Eden of the Flowery Republic," by Joseph Beech, in the NATIONAL GEOGRAPHIC MAGAZINE for November, 1920.)



A SZECHWAN IRRIGATION WHEEL

These Ferris-wheel contrivances are frequently seen along the shores of shallow streams, when the banks are lined with farms. With the exception of the upright supports and the axle, this wheel, some 70 feet high, is constructed entirely of bamboo. Woven bamboo paddles on the rim catch the force of the rapid water in the mill race. Between the paddles are joints of bamboo, open at one end, which scoop up water and empty it into a trough of bamboo poles at the top, which conveys it to the rice fields, 50 or 60 feet above the river level.

THE GIANT HEAD OF BUDDHA AT KIATING, SZECHWAN

A "tea-money" tip was given the man who stands on the crown of the statue to provide a "yardstick" for comparison. Grass and ferns hide the carved curls of the head. Whitewash on the red sandstone gives the effect of a light, flesh-colored pink, weathered in patches. About once in ten years the face is gone over, scraped and repainted, by some devotee of the Buddha, which has been carved from a cliff that rises from the banks of the Min River opposite Kiating. The roofs of a temple can be seen to the left.

Photographs by Rev. Archibald G. Adams

A STREET SCENE IN CHENGTU

Photographs by Rollin T. Chamberlin

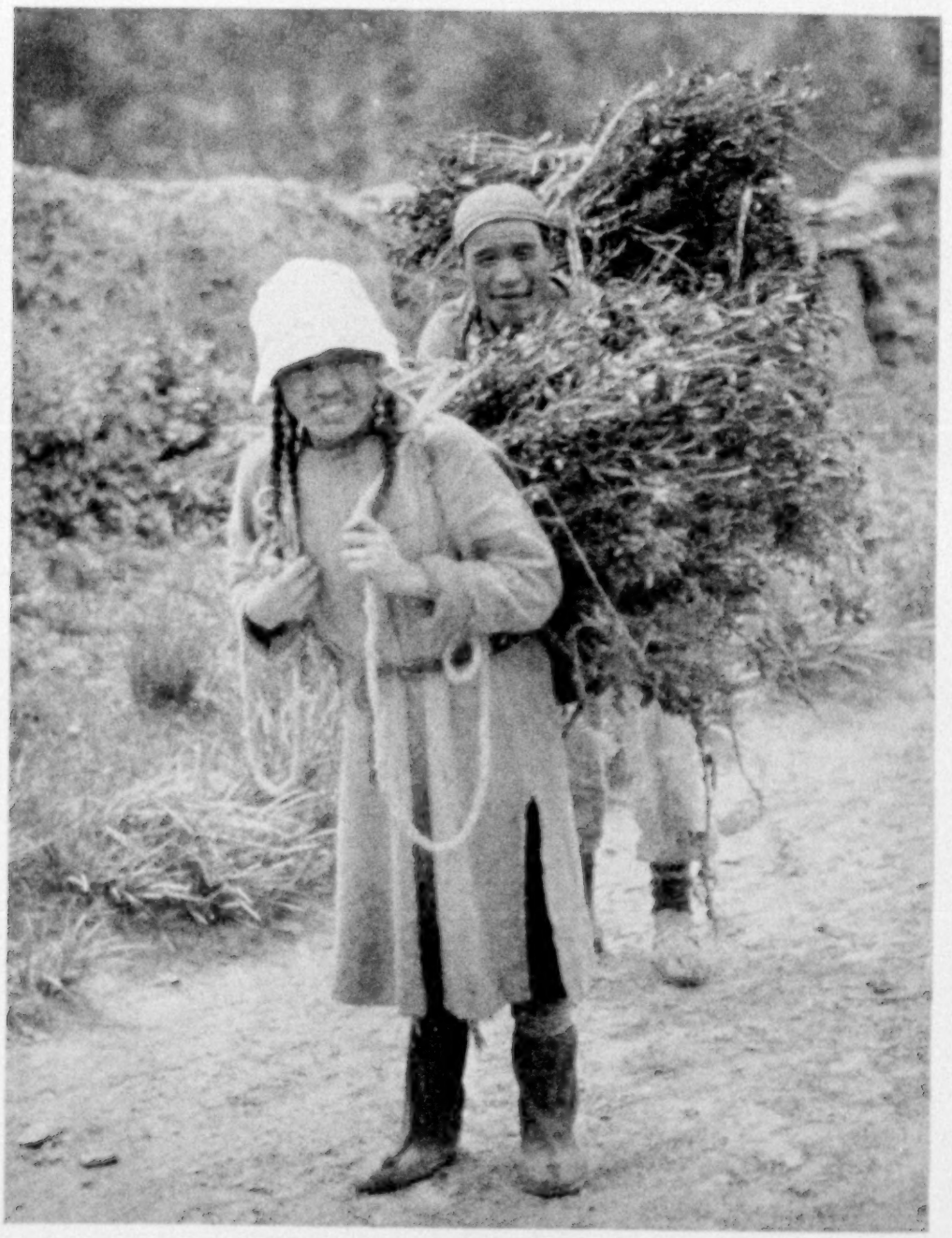
THE MIN, A BRANCH OF THE YANGTZE, BELOW CHENGTU

In the foreground is the end of a soldier boat for transporting river guards.

troops and immediately returning to Szechwan, armed with a letter from me explaining their presence in Kansu territory, in case they were stopped by hostile soldiers.

The Kansu authorities have been exceedingly kind and courteous to me. In every town I have entered I have been given a royal reception, troops lining up, and band playing, the chief mandarins coming out with their red umbrellas, and mounted police often meeting me 20 miles out of a town and escorting me to tents which have been erected, where refreshments are served.

From Pikow to Kaichow is five days' journey and from there to Minchow (not to be confused with Mienchow of Szechwan) is seven days. In the latter city I stayed four days in a merchant guild where the officials had prepared excellent quarters for me.



Photograph by Frederick R. Wulsin

CHONI TIBETANS BRINGING IN FUEL

The women wear gowns of cream-colored homespun and bright-red trousers.

Minchow is full of Mohammedans and many of them are robbers. I was warned to be careful and not to go out in the evening without a bodyguard of soldiers.

TWELVE MEN TO BE SHOT FOR ATTACK ON EXPLORER

The house in which I lodged was guarded day and night by 30 men, and yet on the second night Mohammedan robbers came and climbed upon the roof of the building, with the evident intention of overpowering my guard and robbing me.

The soldiers were on the alert, however; the ringleader and four men were captured. The prisoners were brought into the courtyard and bound to posts, where I interviewed them the next morning. The officials of Minchow were quite upset about this incident and strengthened the guard.

The captured men were taken in charge by the military, who beat them with bamboo until they confessed and gave the names of the others of the band and the whereabouts of their headquarters. The next day their stronghold, four miles from Minchow, was raided by soldiers and seven other robbers were brought in. They were all to be shot after I had left Minchow.

Photograph from Joseph F. Rock

THE PRINCE OF CHONI AND THE AUTHOR

During his stay in Choni, Dr. Rock lived in the prince's lamasery, in a quiet place with private courtyard. Below the spot where this photograph was taken 500 lamas pray from 4 a. m. to 2 p. m. They are ever busy with trumpets, conch shells, bells, and cymbals, which they accompany in a deep basso profundo.

Photograph by Frederick R. Wulsin

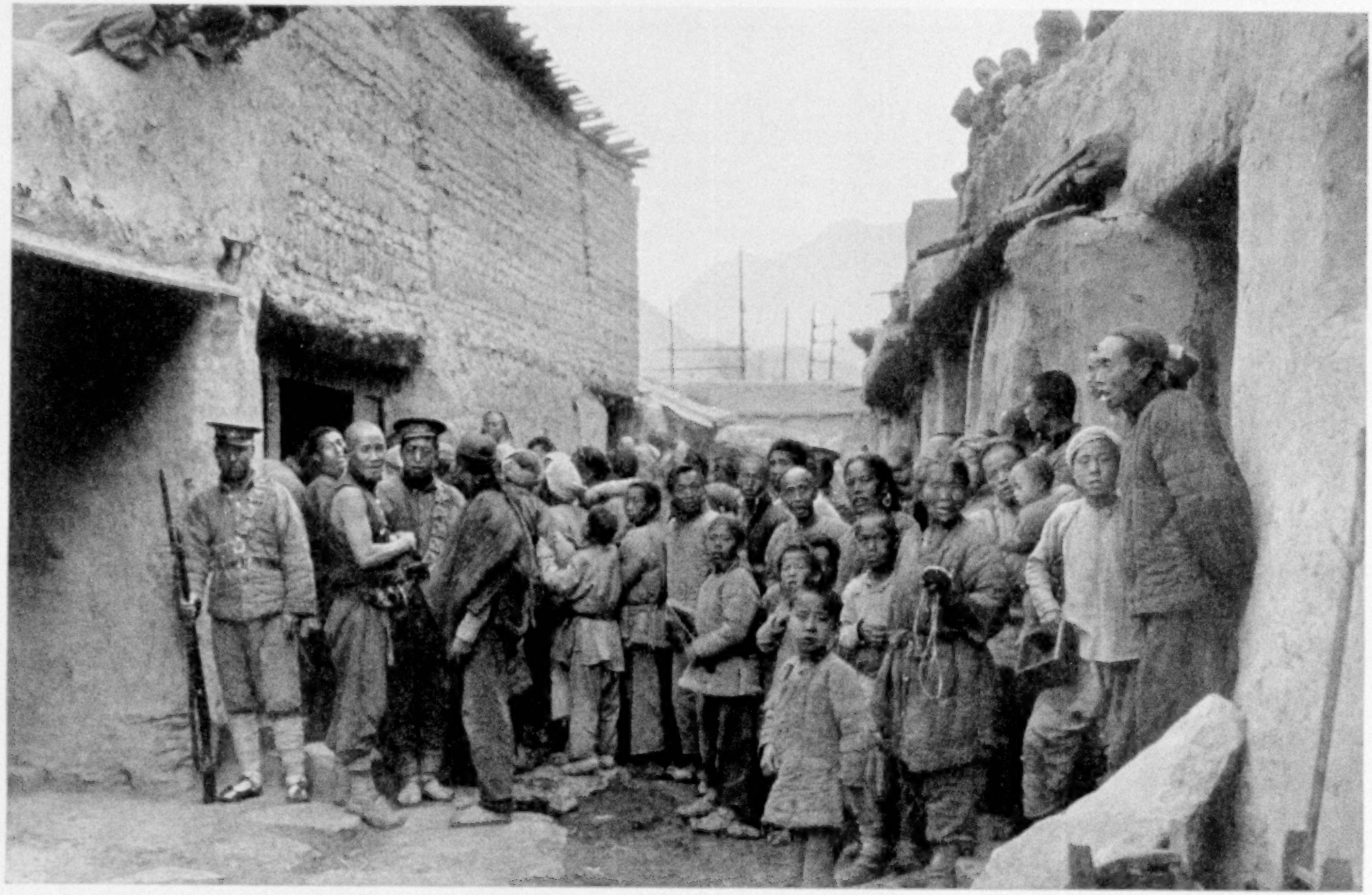
DEVIL DANCERS IN COSTUME AT CHONI

From Minchow I went to Choni, a sort of independent territory ruled by a prince, a Tibetan chief (see illustration, p. 342). Here I learned that the best way to reach the Amne Machin Range was via Radja Gomba, on the Yellow (Hwang) River.

LIVING BUDDHA OF LABRANG IS IN EXILE

I asked the prince if he could help me to get to Radja Gomba, and he said the best way would be to see the Great Living Buddha of Labrang Monastery and ask his aid. The prince wrote to him personally and also gave me a letter of introduction. This Living Buddha, considered the third great incarnation, next to the Pantshen Lama of Tashi Lunpo, lives in exile.

The Mohammedan General Machi of Sining had taken Labrang some time previously, and recently had demanded 270,000 ounces of gold from this rich and most influential monastery; thereupon the Living Buddha left as a protest and is now wandering about from one monastery to another. At the present time he is in the Choni prince's territory, and I visited him at Ankurgomba, a small lamasery in the mountains near Taochow. He was exceedingly friendly and gave me a letter bearing his seal and addressed to the lamas of Radja Gomba monastery, demanding that they receive me well and escort me to the Amne Machin Range, making the tour around it.



Photograph by Joseph F. Rock

THE HOUSE IN WHICH THE AUTHOR STAYED AT A VILLAGE IN SOUTH KANSU

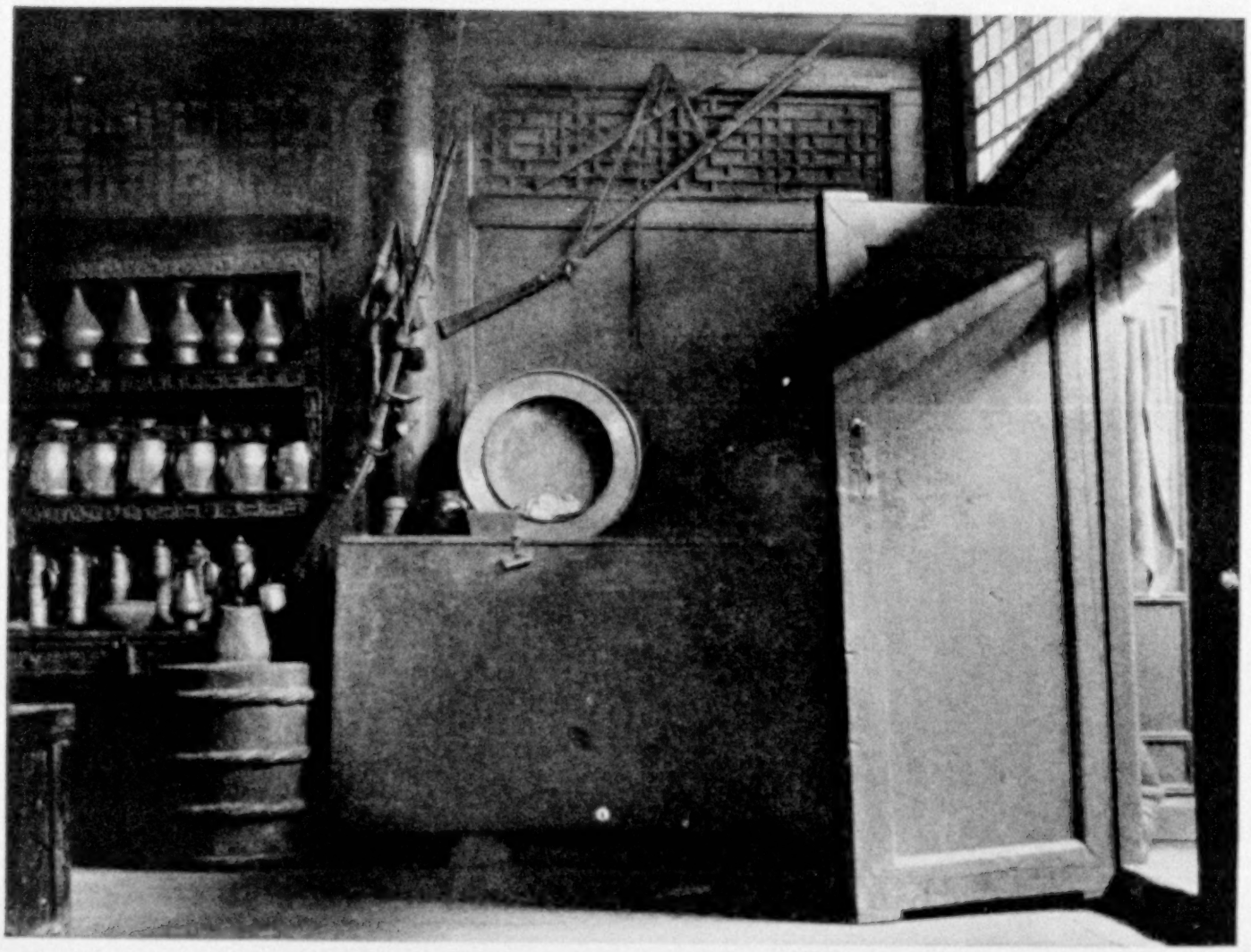
A crowd is listening to Dr. Rock's phonograph, which is playing the sextet from "Lucia." Soldiers are standing guard at the entrance to the house.

XUM

Photograph by Frederick R. Wulsin

TWO YOUNG LAMAS SHOWING HOW SIX-FOOT TRUMPETS ARE PLAYED: LABRANG

These trumpets play an important part in the services at Labrang, which is normally the seat of one of the three most powerful of the Great Living Buddhas. The town was recently captured by a Mohammedan general of Sining, however, and the Living Buddha is now in exile (see text, page 343).



Photograph by Frederick R. Wulsin

THE KITCHEN OF A RICH CHONI TIBETAN

Note the matchlock gun on the wall, the abundance of pewter and copper vessels, and the room's fine paneling.

It takes seven days to go around the Amne Machin peaks, and the Radja Gomba lamas are to arrange safe conduct with the Ngoloks of this region.

EXPEDITION TO AMNE MACHIN PEAKS IS ARRANGED

I stayed first in Taochow, then went to Hetso Gomba, a large but very unfriendly monastery in the Tibetan grass country, where I made purchases of sheepskin coats for my men, Tibetan boots, woolen caps, etc., for the coming cold.

From Hetso I returned to Choni to make final preparations.

If I had gone to Sining, I am sure General Machi would have stopped me. As it is, I arranged with the new Mohammedan sect at Old City Taochow to take me in to Radja Gomba.

This Mohammedan sect, called the New Sect, is a recent religious organization, at the head of which is a wealthy Moslem who calls himself Jesus the Savior. His followers trade with the Tibetans of Radja Gomba and the Ngoloks of the Amne Machin. Their men go in twice a year with about 200 head of yak laden with salt, chili peppers, cotton cloth, trinkets of brass, brass kettles, etc., and bring out in return furs, musk, and other valuables from the Ngolok country.

These men bought for me 22 yaks and have allotted me five carriers and a headman, all of whom have been to Radja Gomba, which is 16 days from Taochow.

THE FIRST WHITE MAN TO VISIT AMNE MACHIN PEAKS

At Radja Gomba the Yellow River is crossed on inflated pigskins, and from there it is four days to the Amne Machin peaks.

So all arrangements have been made, and I am ready to start in about a week, not to emerge until next November.

Armed as I am with the valuable letter of the Living Buddha of Labrang, I think I shall have little difficulty in reaching my goal, the Amne Machin. There are, however, rumors about that the Tibetans are preparing to fight General Machi and that the Ngoloks are ready to join the Tibetans!

General Machi has been taxing the nomad Ngoloks for grass and water, so much for every head of cattle. This the independent Ngoloks refuse to pay, and there is a general revolt on. I only hope this will not interfere with my journey.

I have many photographs, some very interesting ones, and later on I hope to be able to write you an account of my trip to the famous peaks. I shall be the first white man ever to visit the Amne Machin and the first to cross the Yellow River at Radja.

MONEY IS UNKNOWN AMONG NGOLOKS

I have brought many trinkets for the Ngoloks, as money is an unknown quantity among them. Even at Taochow and west of Taochow silver dollars are not wanted, the conservative Tibetans still using lump silver.

I have supplied myself with several thousand taels of silver and a scale to weigh the pieces, a very primitive way of doing business. However, one must conform to the customs and habits of the people .

The money question is a very difficult one in this country. In Chengtu, for example, the silver dollar has 3,600 cash, in Mienchow 3,700 cash, in Pikow 3,200 cash, in Minchow 2,600 cash, in Choni 2,200 cash, and in Hetso 1,800 cash.

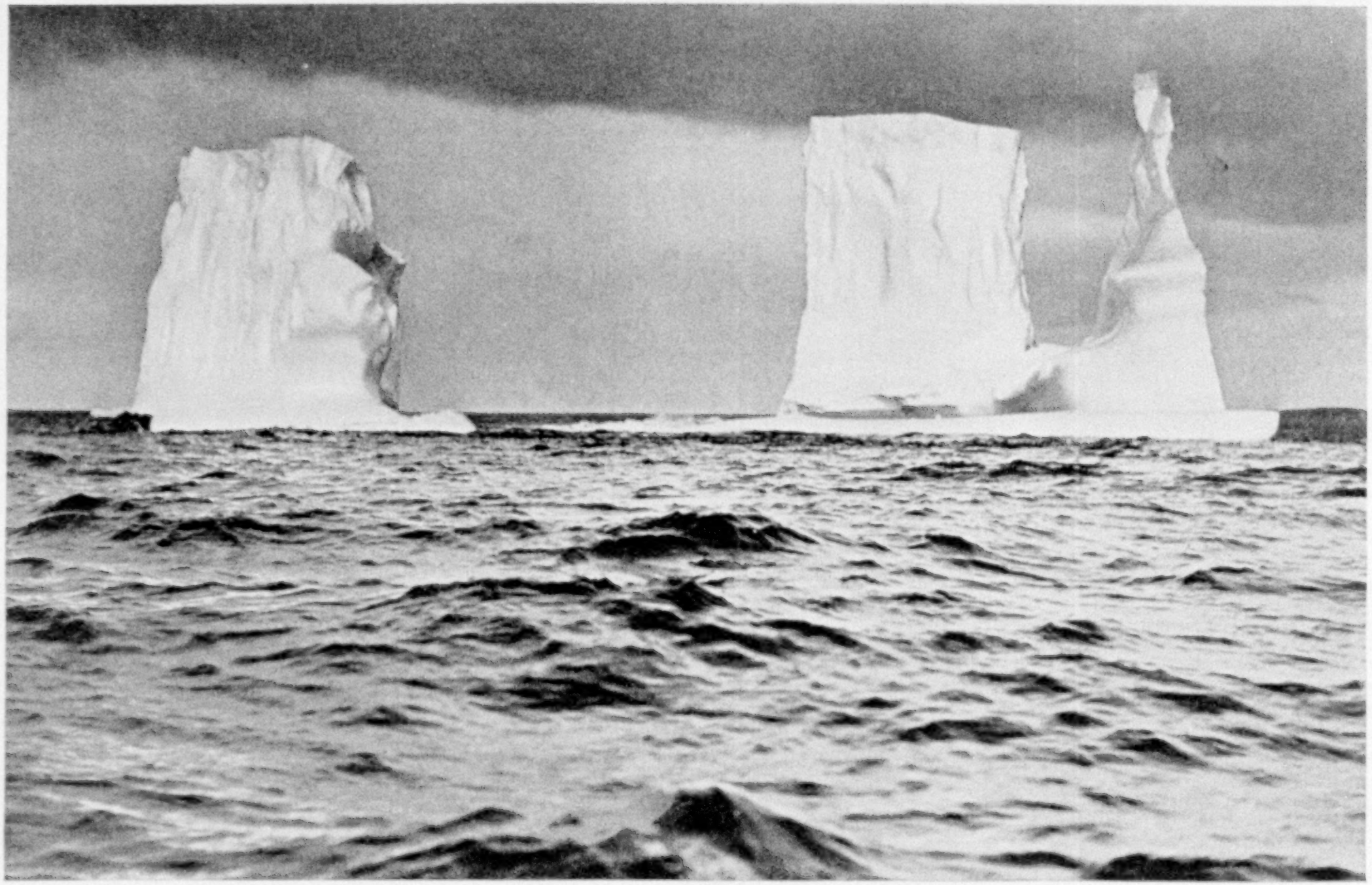
In Pikow the 100 and 200 cash copper pieces are taken, north of Pikow only the 100 cash pieces, and north of Kaichow only the 50 cash pieces, at Minchow only the 10 and 20 cash pieces made of copper and of brass, some yellow and some red! At Hetso they only take the red ones. Of the silver dollars, only the Yuan Shih-kai third-year dollars are accepted; those of the fourth to tenth year are refused, as they say Yuan Shih-kai died the third year, so there cannot be any tenth year of Yuan Shih-kai!

Szechwan and Hupeh dollars are not taken at all. There are several issues of Yuan Shih-kai dollars and some are a little lighter than others, and those are taken at a discount. If they have a tiny scratch on them they are refused, or else accepted at a discount of five to ten cents per dollar. As I said, west of Taochow only lump silver is taken. It is a real cross-word puzzle.

You will hear again from me when I shall have emerged from the Ngolok country. If you do not hear from me, well, then, it may be that I shall have found a final resting place in that land. This is my last word to you until November or December, when I hope to turn up again either at Taochow or Sining. My plan is next year to explore the Richthofen Range and then come out through Chinese Turkestan.

Once more, au revoir, not good-bye.

Notice of change of address of your GEOGRAPHIC MAGAZINE *should be received in the office of the National Geographic Society by the first of the month to affect the following month's issue. For instance, if you desire the address changed for your November number, the Society should be notified of your new address not later than October first.*



Photograph by Maynard Owen Williams

THE FIRST ICEBERGS ENCOUNTERED BY THE MACMILLAN ARCTIC EXPEDITION, OFF THE COAST OF LABRADOR

SCIENTIFIC ASPECTS OF THE MACMILLAN ARCTIC EXPEDITION

IT IS hoped that by the time this number of the NATIONAL GEOGRAPHIC MAGAZINE reaches the reader a large part of the program of the MacMillan Arctic Expedition, which took the field under the auspices of the National Geographic Society, the U. S. Navy coöperating, will have been accomplished.

However, pending the complete narrative of the expedition's work by the leader, Commander Donald B. MacMillan, which will appear in an early issue, it will be of interest to the members of the National Geographic Society, each of whom has had an equal share in financing the undertaking, to learn further details of the organization of the exploring party and its personnel.

The full roster of the expedition, which went north on the converted mine-layer *Peary* and the oil-burning yacht *Bowdoin*, is as follows:

ABOARD THE "BOWDOIN"

Donald B. MacMillan, in command of Expedition, Freeport, Maine.

Ralph P. Robinson, mate, Merrimac, Massachusetts.

John M. Jaynes, engineer, Somerville, Massachusetts.

Benjamin H. Rigg, magnetic observer, tides and currents, loaned by the U. S. Coast and Geodetic Survey, Burlington, New Jersey.

Maynard Owen Williams, staff correspondent, National Geographic Society, Washington, D. C.

John L. Reinartz, radio operator, Manchester, Connecticut.

Onnig Melkon, sailor and photographer, South Weymouth, Massachusetts.

Martin E. Vorce, cook, Somerville, Massachusetts.

Richard Salmon, sailor, Larchmont, New York.

Kennett Rawson, sailor, Chicago, Illinois.

ABOARD THE "PEARY"

NAVY PERSONNEL.

Lieutenant Commander Richard E. Byrd, Jr., U. S. N., in command of Navy personnel.

Lieutenant Mienrod A. Schur, U. S. N., San Diego, California.

Chief Boatswain Earl E. Reber, U. S. N., Millville, New Jersey.

Andrew C. Nold, aviation pilot, U. S. N., South Bend, Indiana.

Floyd Bennet, aviation pilot, U. S. N., Waterbury, Vermont.

Nels P. Sorensen, aviation chief machinist's mate, U. S. N., Menominee, Michigan.

Albert Francis, chief aërographer, U. S. N., San Francisco, California.

Charles F. Rocheville, aviation machinist's mate, first class, U. S. N., Coronado, California.

E. F. McDonald, Jr., in command of *Peary* and in charge of radio, Chicago, Illinois.

George F. Steele, captain, Roxbury, Massachusetts.

Hosmer L. Freeman, mate, South Weymouth, Massachusetts.

W. D. Publicover, chief engineer, West Somerville, Massachusetts.

Dr. Walter N. Koelz, ichthyologist of the U. S. Bureau of Fisheries, Ann Arbor, Michigan.

Jacob Gayer, staff color photographer, National Geographic Society, Washington, D. C.

Dr. Leo M. Davidoff, surgeon, Peter Bent Brigham Hospital, Cambridge, Massachusetts.

P. D. Davidson, first assistant engineer, Portland, Maine.

Paul J. McGee, radio operator, Mattoon, Illinois.

Harold E. Gray, radio operator, Chicago, Illinois.

Edward MacNamara, seaman, East Boston, Massachusetts.

William Parker, fireman, New Orleans, Louisiana.

Henry King, seaman, Cambridge, Massachusetts.

Adolph Harloff, cook, East Boston, Massachusetts.

E. G. Freel, fireman, South Boston, Massachusetts.

Van R. Brown, fireman, Charlestown, Massachusetts.

John Kenney, messman, Rosindale, Massachusetts.

Rufus Sewall, officers' mess, Wiscasset, Maine.

John MacNamara, seaman, Everett, Massachusetts.

Ernest MacNamara, seaman, Boston, Massachusetts.

WIRELESS REPORTS INDICATE SUCCESSFUL SCIENTIFIC WORK

Wireless reports, which have been received at the headquarters of the National Geographic Society in Washington from the ship's base at Etah, Greenland, and which have been released to the newspapers daily, indicate that the scientific aspects of the expedition have been extremely fruitful, and it is believed that the technical experts are bringing back to the United States data in the form of field notes, natural history specimens, atmospheric and tidal observations, and natural-color photographs which will prove of ex-

Photograph by Maynard Owen Williams

LIEUTENANT RIGG INTERVIEWS A RESIDENT OF BATTLE HARBOR, LABRADOR

The *Peary* and the *Bowdoin* touched at Battle Harbor and at Hopedale, Labrador, the former vessel taking on coal at Hopedale before sailing for Godhavn, Greenland. The *Bowdoin* damaged her propeller and had to put back to Hopedale, where Commander MacMillan, crew, and scientists alike struggled feverishly for five days before a new propeller could be installed. After the yacht had been beached the entire cargo had to be shifted to the bow in order to tilt the stern upward sufficiently to make the repair at low tide. MacMillan, in a radio message describing the difficulties of the feat, added that his crew was composed of the finest men who had ever sailed north with him.

ceptional value in answering many hitherto moot questions as to the flora, the fauna, and the meteorology of Arctic regions.

The painstaking observations and the numerous specimens collected by Dr. Walter N. Koelz, loaned to the expedition by the U. S. Bureau of Fisheries and the University of Michigan, are expected to prove important additions to our knowledge of the fishes and birds of the Arctic regions.

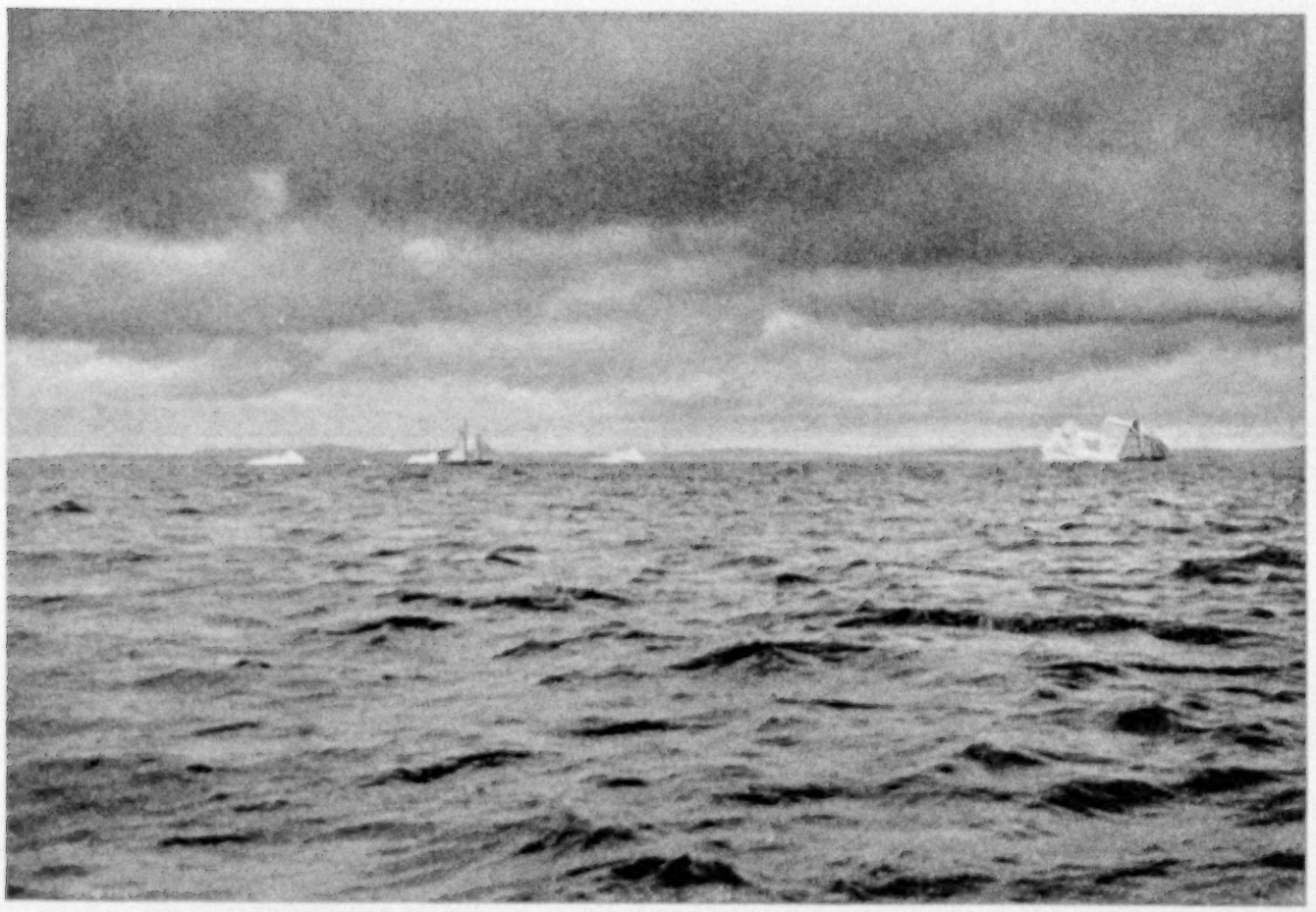
Dr. Koelz has been observing and collecting in a practically virgin field; for, with the exception of work done in Spitsbergen and a few random specimens collected incidentally from time to time by explorers, the Arctic fauna has not been concentrated upon by scientific observers in the past. Among the species studied by Dr. Koelz are several gulls about which nothing has been known hitherto. Information concerning Arctic hawks has also been entirely lacking and much is needed to fill out the life history of the blue goose.

In making his marine collections Dr. Koelz has depended largely upon gill nets with square meshes having open spaces about five-eighths and three-eighths of an inch across. Short lengths were spliced, making single nets up to 1,000 feet in length.

EQUIPMENT AND SUPPLIES CARRIED BY NATURALIST

Collecting fish, birds, and mammals in the Arctic is a difficult undertaking, necessitating much equipment to provide against loss, so far removed from supplies.

Hundreds of pounds of special supplies and equipment were taken along, and problems of packing and transportation involved in getting the specimens safely back to the United States had to be worked out. Dr. Koelz took aboard the *Peary*



Photograph by Maynard Owen Williams

OUTPOSTS OF THE ARCTIC ICE OFF LABRADOR

the following: 15 gallons of formaldehyde, 20 gallons of alcohol, 100 pounds of salt, 2,000 feet of gill nets made of linen thread, trammel nets, dozens of thermometers, automatic water-sampling bottles, silk bolting cloth to seine up the almost microscopic food of the fish, dredges for creatures living on the sea bottom, insect nets, plant presses, and a number of copper tanks for use in preserving fish.

Because space was at a high premium on the *Bowdoin* and the *Peary*, there was much improvision. After his fish were "pickled" in alcohol and formaldehyde, Dr. Koelz commandeered empty gasoline drums in which to bring the specimens back to the United States. The fish are preserved whole and will eventually repose in glass jars of alcohol.

The preservation of bird specimens is simple. The skins are split and slipped off with the feathers still in place. The neck is then severed, so that the head and skin remain. These are generously salted and, after drying, are packed away. Because they can be packed flat the bird skins take up little space. Hundreds of them have been stowed away in ordinary wooden packing cases. Back home these skins will be softened by washing out the salt, will be stuffed with excelsior, and mounted, being thus restored to a lifelike appearance.

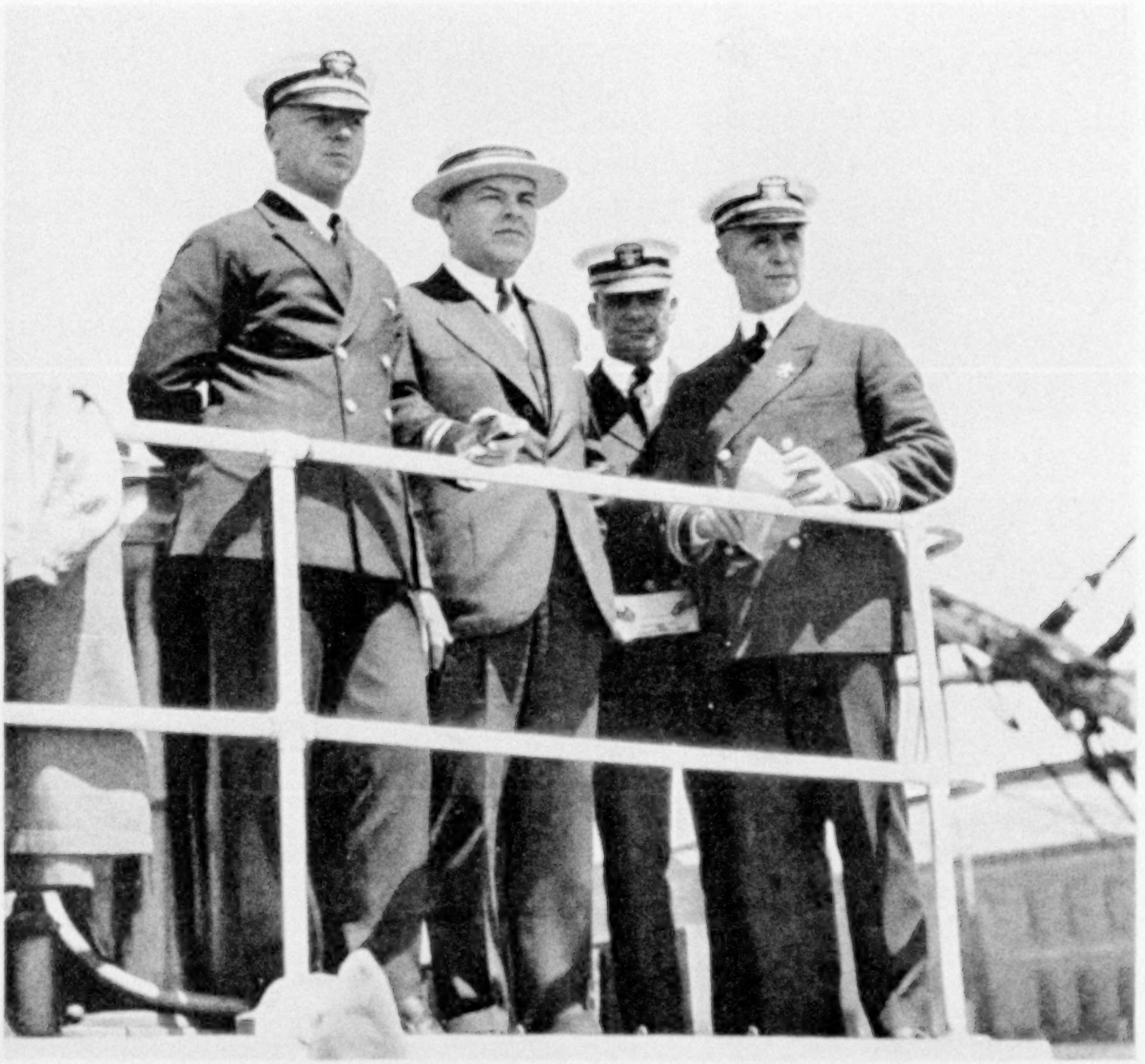
The skins of land animals have been dressed and numerous photographs are being brought back to aid taxidermists in devising lifelike mountings.

Experiments have been undertaken to determine the temperature of the water at various depths, and these fluctuations have been studied in relation to the zones of undersea life.

UPPER AIR TEMPERATURES CHARTED

Prior to the work of Commander MacMillan's party, upper air temperatures in the Far North were almost as little known as the secrets of the million-square-miles "blind spot" on the map. Summer records of these conditions not only will be of value to aviation in the future, but may have a direct bearing on weather forecasting.

Forecasting weather consists largely in detecting new disturbances as they show up on the western and northwestern borders of the United States, learning their



Photograph by Maynard Owen Williams

WHEN THE EXPEDITION WAS READY TO SAIL

On the bridge of the *Peary*, from left to right: Lieutenant Mienrod A. Schur, U. S. N., of San Diego, California; Mr. John Oliver LaGorce, Vice-President of the National Geographic Society, who accompanied the expedition to Wiscasset, Maine, to wish the party godspeed; Chief Boatswain Earl E. Reber, U. S. N., of Millville, New Jersey; and Commander Donald B. MacMillan, leader of the expedition. The Navy's personnel of eight is under the command of Lieutenant Commander Richard E. Byrd, Jr.

characteristics, and figuring out the paths they probably will follow because of prevailing barometric pressures and temperatures ahead of them.

The majority of what the weather forecasters call the "lows"—that is, the areas of subnormal barometric pressure—seem to originate over the warm sea south of the Aleutian Islands in the winter and over the interior of Alaska during the summer; but some of the conditions which cause these "lows" to be "built up" in those places and create "highs" to the east have their birth farther north in the Polar regions, and a better knowledge of temperatures, pressure, and wind changes there will, it is hoped, facilitate weather forecasting.

In the search for the beginnings of its weather, the United States is not concerned with the entire Polar area, but chiefly with the region north of Alaska.

Most of the meteorological work has been done by Mr. Albert Francis, chief aërographer.

Temperatures, pressures, and wind con-

Photograph by Maynard Owen Williams

DR. GRENFELL AND MISS FERRIS, A GRADUATE NURSE IN CHARGE OF THE INTERNATIONAL GRENFELL HOSPITAL AT FORTEAU BAY, WITH HER DOGS

Miss Ferris drives her own dog team and is so expert that she can outdistance most of the men. Since she inaugurated the custom of driving her team, the Labrador women have imitated her.

ditions—the vital weather factors—are not known in the regions north of Alaska to the Pole. Exploration of this area is preliminary to making detailed observations of these conditions, which directly affect farms and orchards of the United States.

Mr. Francis carried to the north on the *Peary* elaborate aërological equipment, consisting of wind measuring instruments for the winds in the upper air as well as for surface winds. These instruments were installed and placed in operation as soon as the expedition reached the ship's base at Etah.

Other equipment included instruments to measure the barometric pressure and atmospheric temperature and humidity at the surface and in the upper air. Numerous observations were taken daily and these were transmitted by radio to Washington whenever practicable so that they might be used in the preparation of the daily weather map issued at the Capital by the Weather Bureau.

It was Mr. Francis' main duty to take upper air observations before each flight made by the Navy planes, and conditions were studied to determine the kind of weather which probably would be encoun-

XUM

tered during each flight. Weather forecasts were prepared by the aërographer in so far as was practicable from the meager data available in Arctic Regions.

A special study has also been made of all unusual meteorological phenomena and photographs relating to these phenomena have been obtained in many instances.

All aërological observations have been carefully recorded and a journal has been written to assist in their interpretation. These data, it is hoped, will form the basis for an analytical study of Arctic conditions upon the return of the expedition.

Mr. Francis has also had charge of the Navy's photographic equipment.

COAST SURVEY REPRESENTATIVE STUDIES TIDES AND SOUNDINGS

Lieutenant Benjamin H. Rigg, loaned to the expedition by the United States Coast and Geodetic Survey, has carried on an important series of observations of tides, currents, water temperatures, and densities.

Tidal observations have been made at every point possible. At places where less than three days were spent the readings were made on a plain staff every hour, except near the times of high and low water, when readings were taken every five or ten minutes. Where a stop of three days or more was made, the readings were taken with a portable automatic tide gauge in connection with the plain staff.

Wherever practicable, bench marks were established in connection with the tide staffs, so that the planes of reference determined by these observations might be recovered at future times. Whenever possible, Lieutenant Rigg established three standard bench marks.

Current observations have also been made by means of a current pole about 15 feet in length, weighted with sufficient sheet lead to submerge all except one foot of it. A log line graded for 60-second run was used in connection with this pole, the 60-second interval being determined by a stop watch.

In many instances it was possible to make observations with the current pole every hour, and in addition observations were made half-hourly with a Price current meter at three depths—one-fifth, one-half, and four-fifths of the depth at each station, except that the lowest observation was not made below 80 feet. In most cases the observations began at the depth nearest the surface, and in every case the exact time of the observation was recorded.

Whenever practicable, temperatures and densities of the sea water have been taken twice a day—at 8 a. m. and 8 p. m. in most instances. Like the current observations, those of temperature and density have been made at three depths—one-fifth, one-half, and four-fifths of the depth of the station. These temperature observations have been made with a deep-sea thermometer in a reversible frame, and the water samples for density determination were secured with the Sigsbee specimen water bottle, the density being determined with a hydrometer in the usual way.

Lieutenant Rigg's equipment included a portable automatic tide gauge, complete with 20 feet of 3½-inch pipe; a plain staff 12 feet long; a stop watch; a log line, graduated for 60-second run; a Sigsbee specimen water bottle; two sets of hydrometers, a hydrometer jar, two deep-sea thermometers; a reversing frame for deep-sea thermometer; a water thermometer, and an air thermometer.

It is believed that Dr. Leo M. Davidoff, the surgeon of the expedition, will have much to contribute to its achievements from a scientific standpoint. His researches have been wide, for the general good health of the personnel has left him free to study many natural history specimens collected in the Arctic.

All in all, the members of the National Geographic Society may well feel gratified at the scientific data collected by the expedition which they have sponsored.

Do you know "the latest style" in soup!

I'll sing a song—it isn't long
But certainly worth while:
"The vogue's decree,
You'll plainly see,
Is Campbell's Soup for style!"

Do you realize that in this age of better quality and greater convenience, the "fashion" in soup, as in almost everything, favors the product which has been made by the trained specialist?

It is simply a "sign of the times" that critical and capable housekeepers select Campbell's Soups—those delicious blends of the choicest ingredients, prepared by skilled French chefs in the greatest soup-kitchens in the world.

Campbell's Tomato for example. It is literally the country's standard for tomato soup. It graces the finest tables in the land. It is "the thing" to serve—the tomato soup that is always enjoyed.

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Look for the Red-and-White Label

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More people enter our homes and offices by telephone than in person. Through the telephone door, traveling by wire, comes a stream of people from the outside world on social and business missions. Important agreements or appointments are made, yet the callers remain but a few seconds or minutes and with a "good-bye" are gone. We go out through our telephone doors constantly to ask or give information, buy or sell things, make personal calls and on dozens of other errands.

None of the relations of life is more dependent upon co-operation and mutual consideration than these daily millions of telephone journeys. It is the telephone company's part to furnish the means of calling and to place courteous and intelligent employees at the service of the public. Good service is then assured when there is a full measure of co-operation between users.

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BONDS · SHORT TERM NOTES · ACCEPTANCES

This is the new way to finish a shave

WHEN you wash off the lather after shaving, you take away some of the skin's natural moisture. To keep your skin pliable and free from chapping, you must conserve its natural moisture.

So, after shaving don't leave the skin totally unprotected. Don't put on preparations which absorb moisture. For all-day comfort, *help the skin retain its own natural moisture.*

Aqua Velva is a new preparation made by us expressly for this purpose. *It conserves the skin's moisture.* After shaving just pat on a few drops:

—it tingles delightfully when applied
—it gives first aid to little cuts
—it protects the face from sun and wind
—it prevents face-shine
—it delights with its man-style fragrance

Thousands of men are now keeping their faces soft and comfortable in this new way. Try it. A 150-drop test bottle will be sent you *free*. Use coupon below or postcard.

The large 5-ounce bottle at your dealer's is 50c (60c in Canada). Costs almost nothing a day—only a few drops needed. *By mail postpaid on receipt of price if your dealer is out of it.*

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for use after shaving

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(If you live in Canada, address The J. B. Williams Co., Limited, St. Patrick St., Montreal)

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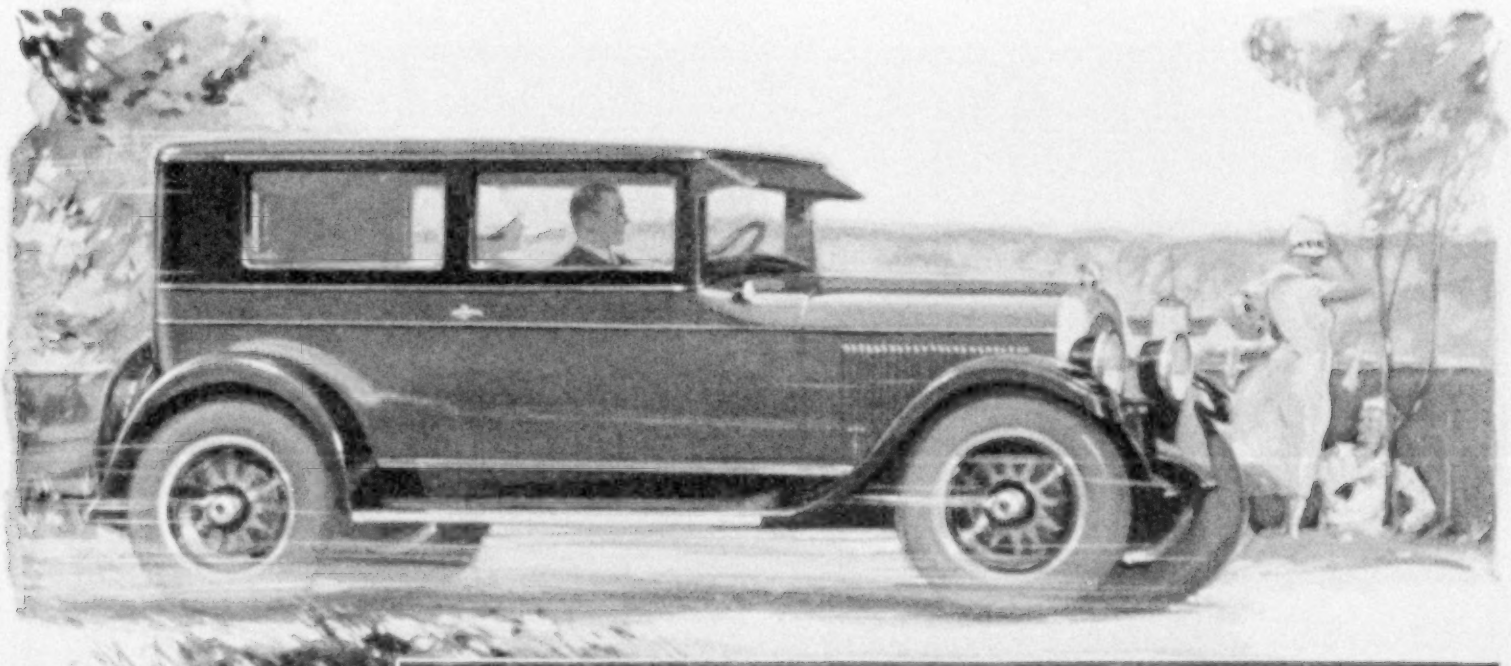

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Your own eyes will recognize why it has completely captivated every city and town in America.

Never did a car appeal so strongly to those whose pride is smartness, beauty and alertness—never was a car so nearly effortless in handling.

For the Chrysler Six responds to your will as if it were a part of you. It inspires even the most timid with assurance that brings a novel delight to driving.

It spurts smoothly and easily ahead, it turns, it slows or stops, even as you think the thought.

There's joy—new joy—in the lives of those who own and drive the Chrysler Six.

They joy in its satiny smoothness as its soaring power carries them over the road—

But they thrill even more to the new sense of complete mastery it inspires.

Your nearest Chrysler dealer is eager to send a car to your door for a demonstration—yourself at the wheel, if you wish to experience the newest thrill in motoring.

Touring Car, Phaeton, Coach, Roadster, Sedan, Royal Coupe, Brougham, Imperial and Crown-Imperial—attractively priced from $1395 to $2195, f.o.b. Detroit subject to current Federal excise tax.

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There are Chrysler dealers and superior Chrysler service everywhere. All dealers are in position to extend the convenience of time-payments. Ask about Chrysler's attractive plan.

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CHRYSLER CORPORATION OF CANADA, LIMITED, WINDSOR, ONTARIO

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SUPPOSE you determined to save a certain sum of money in a certain number of years. Suppose you began putting away with a great institution the proper amount each year. Suppose you knew that if anything happened to you, that great institution would pay to your wife, your children, *the whole amount you had planned to save.* Suppose you knew you could in this way combine saving, and safety, and protection. Would you wait until tomorrow to make your first deposit? Such is the Prudential Life Insurance Policy.

There is a Prudential man near you. You incur absolutely no obligation by letting him explain to you how Prudential Policies can relieve your mind of all worry about the future.

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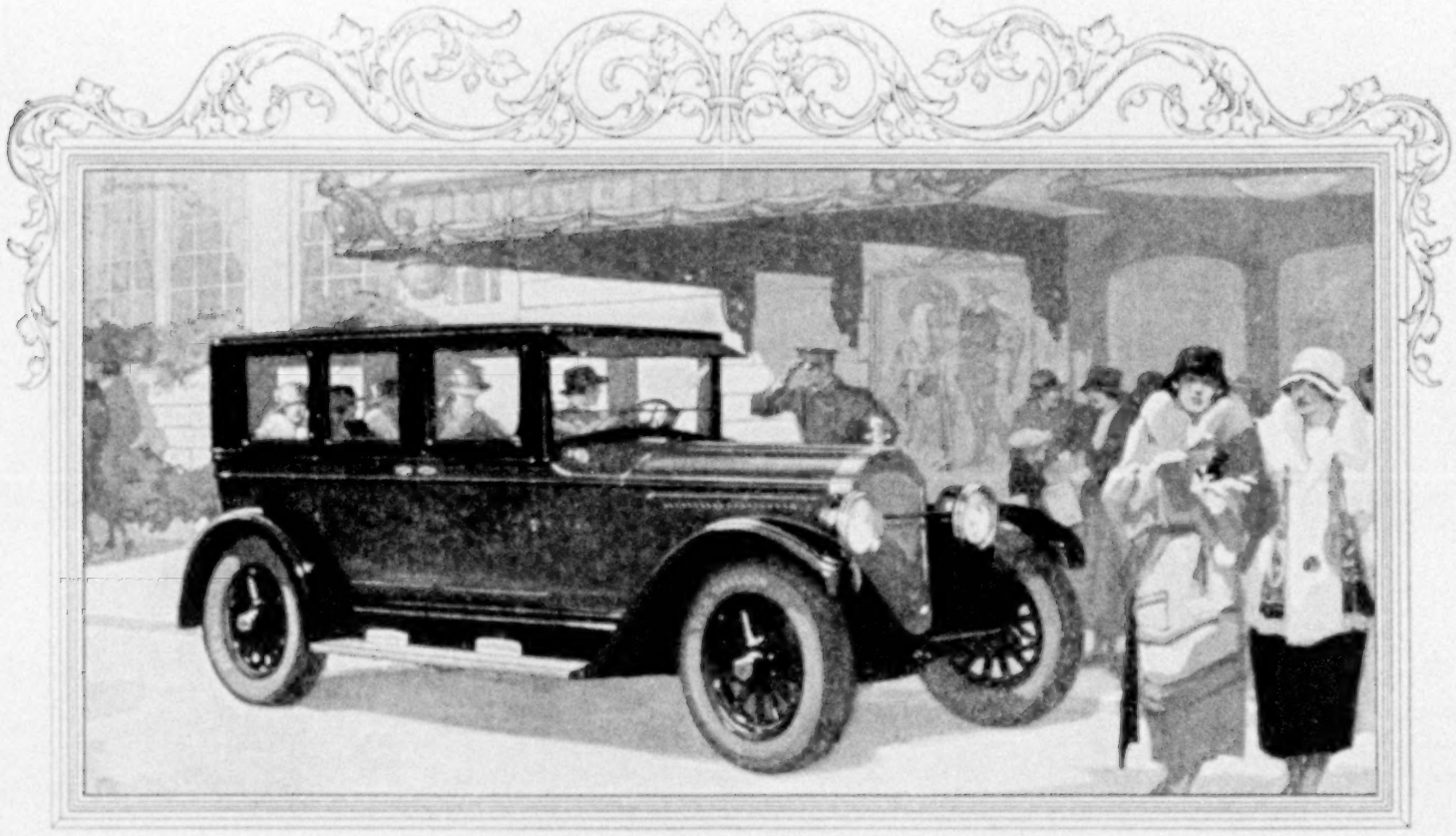
PRUDENTIAL

INSURANCE COMPANY OF AMERICA

Edward D. Duffield, President *Home Office, Newark, New Jersey*



If you knew what every Willys-Knight owner knows, you'd be driving a Willys-Knight car

Up to June 30, this year, there were over 200,000 Willys-Knight cars in active service. And on that day and date, those owners were experiencing a degree of car-satisfaction the average owner wouldn't believe could exist in *any* motor car.

30,000, 40,000, 50,000 miles—not a day out of active commission, not a dollar spent for engine repairs . . . Not an uncommon experience among Willys-Knight owners . . .

No carbon troubles. No valves to grind. The patented Willys-Knight engine does away with both . . .

To this exceptional engine efficiency is added another advantage—*absolute lack of vibration*, due to the Lanchester Balancer. The Willys-Knight is the only car in the United States equipped with this device.

Quite naturally, then, the owner counts on keeping his Willys-Knight two and three times as long as any other car.

Four-cylinder models from $1195 to $1595. Six-cylinder models from $1750 to $2295.
F.O.B. Toledo. We reserve the right to change prices and specifications without notice.

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With an engine you'll never wear out

DODGE BROTHERS
TYPE-B SEDAN

Its exceptional comfort is commented on by everyone who drives it.

Doctors, tourists, salesmen, and all who find it necessary to spend eight, ten and twelve hours on the road at a time, are particularly emphatic in their praise.

The fact is, that with its admirable spring suspension, deep seats and generous lounging room, the Type-B Sedan delights the most exacting seeker after restful transportation.

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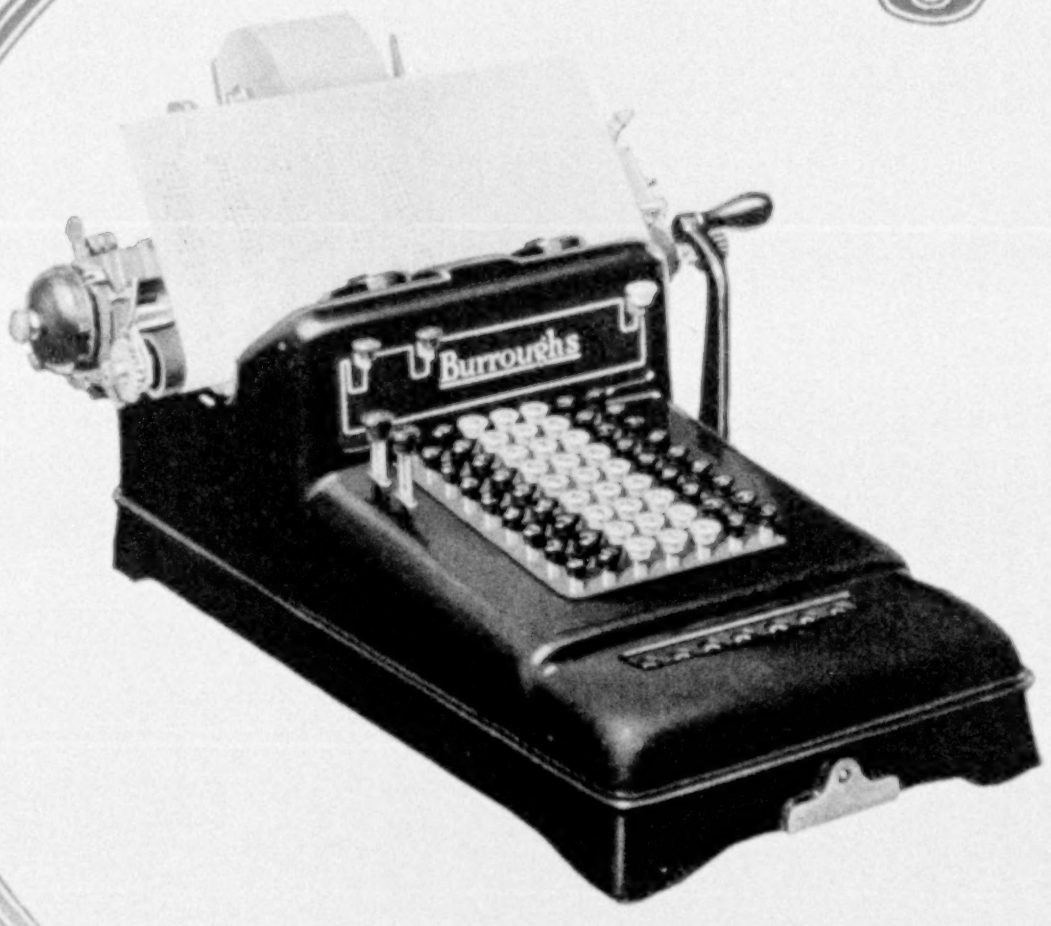

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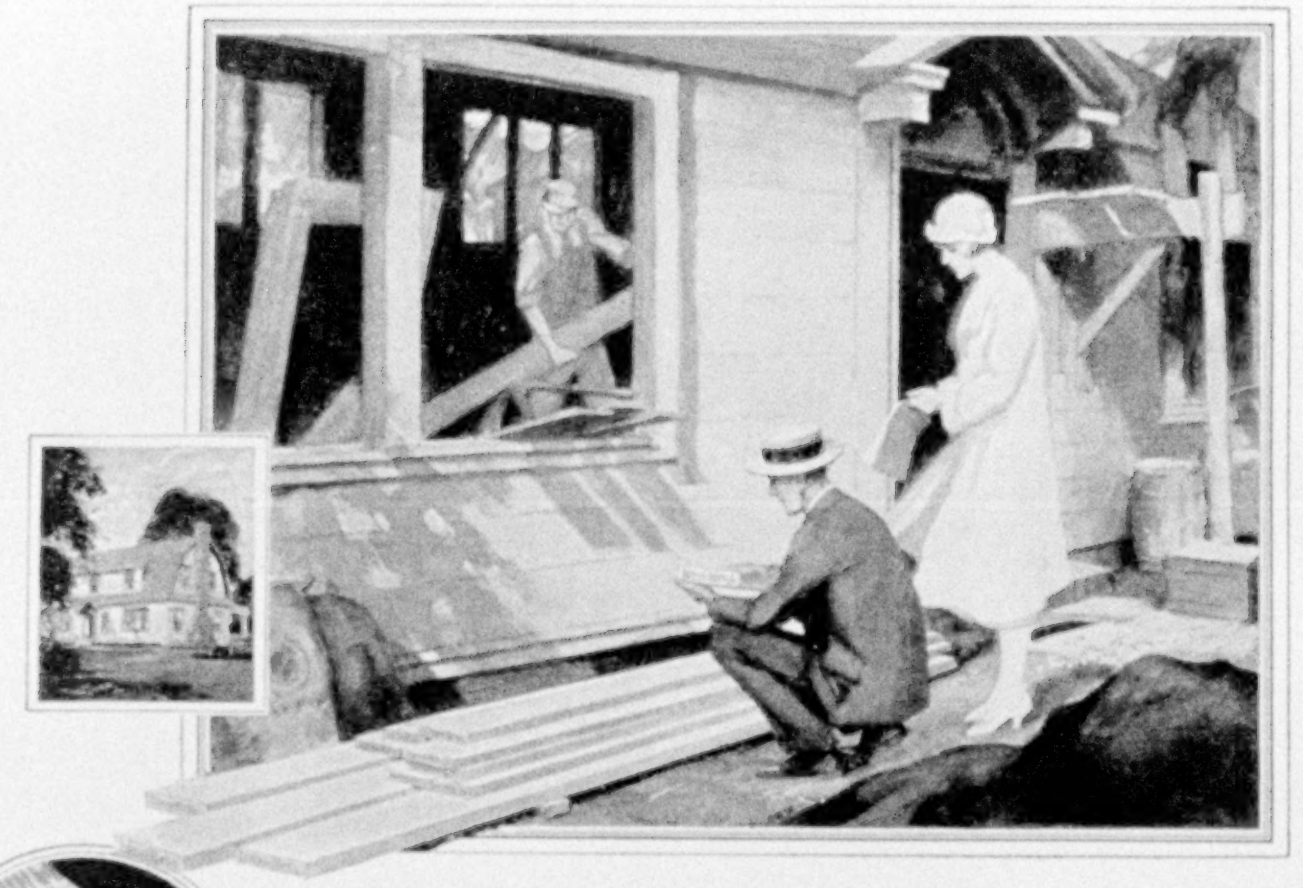

Douglas Fir

Long-Bell production of Douglas Fir lumber and timbers follows high standards. Skilled supervision in modern manufacturing plants at Longview, Wash.—virgin timber from the world's greatest fir region—the trade-mark on every piece—here are the buyer's best assurances of *maximum building value.*

Important =

is the *choice of lumber* in home building

YEARS AGO, with one primary purpose in mind, The Long-Bell Lumber Company made its decision to trade-mark the lumber and timbers it produced: To identify *maximum lumber value* as against "just lumber".

Long-Bell products have been sold and used in constantly increasing volume because Long-Bell production has maintained that standard of maximum value which justifies the manufacturer's name on every piece.

The *choice* of lumber is important. It goes into homes and buildings which must stand the buffets of time. Durable construction demands good lumber.

To give such lumber values, exacting production standards are followed in all Long-Bell plants. From the first operation on, the aim of every skilled workman is *maximum building value.* Today, with its advantageous experiences of fifty years in the business, the company produces trade-marked lumber and timbers *dependable for the best construction.*

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Read This Booklet

Every prospective home builder should have a copy of this interesting booklet, "Saving Home Construction Costs". We will send it complimentary if you will write for it.

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Water-Spar
Water-*Proof* Varnish
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stood the test for 438 miles. "The paddles came back to us good as new, the skin of your Water-Spar Varnish unbroken, while paddles made by guides went to pieces," writes Albert Winslow Company, Manufacturers of Paddles!

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"Guide to Better Homes" sent you free. Equal in information to any five-dollar book on home furnishing and decoration. Write Dept. C today.

PITTSBURGH PLATE GLASS CO.

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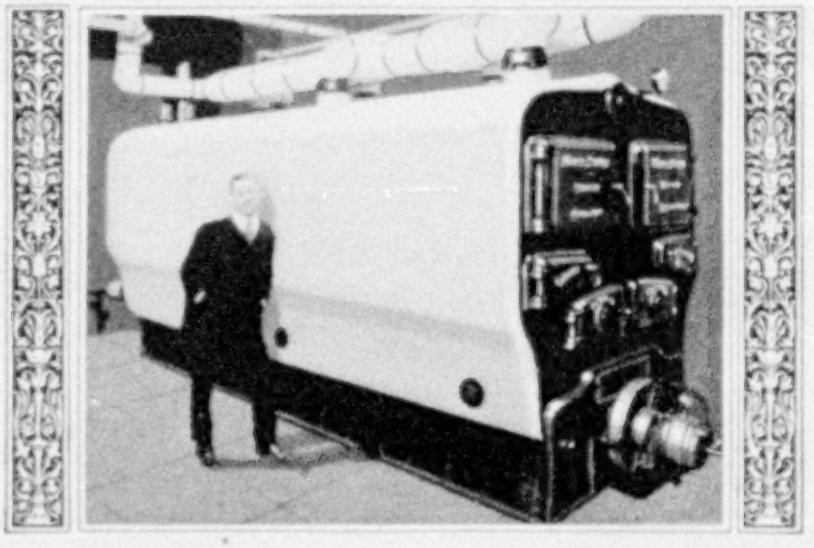
"Here is One of the Most Satisfactory Heating Plants in the Country"



These are the words of Mr. John W. Kelly of the Alaska Plumbing and Heating Company of Portland, Oregon. He refers specifically to the Capitol steam boiler installed by his organization in the Multnomah Block Automotive Building of Portland.

"When we put on the first test," says Mr. Kelly, "the farthest radiator from the boiler was warm in twenty-six minutes from the time the fire was started. This is remarkable performance for a low pressure heating plant carried on one boiler in a building of 228,000 square feet.

"The Austin Company, engineers and builders, believe it to be one of the best and largest single boiler installations of the kind ever made. This Capitol continues to do wonderful work with suprisingly small fuel consumption."

We shall be glad to send you an illustrated booklet which fully explains the modern idea in house heating.

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This new way works wonders on cloudy teeth

Modern science, by perfecting a new way of combating the stubborn film that covers teeth, now opens the road to whiter teeth, *safely*.

THAT cloudy teeth, yellowish, discolored teeth can be made whiter is now an accepted fact. Foremost dentists of the world are widely urging this new method. You can have cleaner, prettier teeth if you will start *today*.

This is accomplished by combating a viscous film that covers teeth. A stubborn, hard to remove film that old type dentifrices do not fight successfully.

Run your tongue across your teeth and you can feel this film. Under it are the clear, attractive teeth you envy in others. Combat it, and your teeth become many shades whiter—more glistening. This offers you a 10-day test free. Mail the coupon.

The great enemy of teeth

Film is the great enemy of teeth beauty. And a chief cause, according to world's dental authorities, of most tooth troubles. It clings to teeth, gets into crevices and stays. Germs by the millions breed in it. They, with tartar, are the common cause of pyorrhea. It holds food in contact with teeth, inviting the acid that causes decay.

You can't have prettier, whiter teeth; you can't have healthier teeth unless you combat that film.

Ask your druggist or mail the coupon for Pepsodent. Don't expect the same results from old type dentifrices. Begin beautifying your teeth today.

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The New-Day Quality Dentifrice

Endorsed by
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Send to:

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Only one tube to a family 1849

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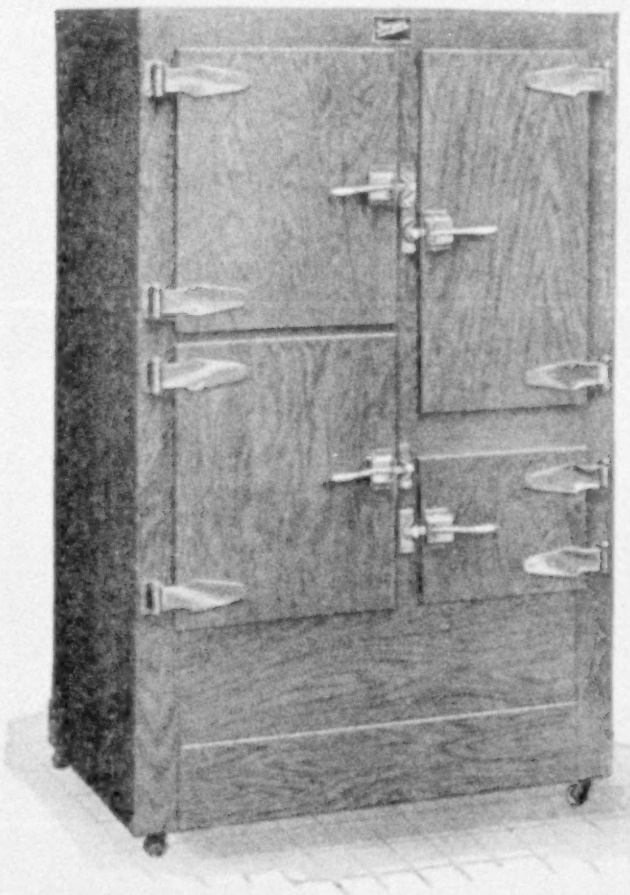

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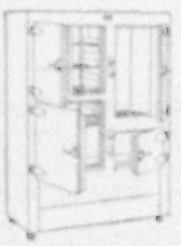

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WHAT the New Improved Gillette promised to do in theory, by virtue of its scientific design, it performs in actual use. It is submitted for the judgment of men whose time, good nature and facial appearance are of sufficient importance to make them demand a faultless shaving implement.

Try it once with a Gillette Blade—possessing the finest edge that steel can take . . . and you will realize that your shaving problem is solved.

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The Gillette New Standard
In gold plate, $6.
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SAFETY Gillette RAZOR

Whether you have a beard "like wire" or as soft as silk, your GOOD shave will become a PERFECT shave if you read "Three Reasons"—a new shaving booklet just published. A postcard request and we'll gladly send you a copy with our compliments.

Hurry-yes-but he still had time for his bath—

A good drenching shower!

SPEED is a feature that everyone appreciates about a shower. In two minutes, you can take a shower bath that cleanses every pore, massages nerve ends and the tiny muscles which lie just beneath the surface of the skin.

Such a bath leaves you cool, refreshed and invigorated—and all in a couple of minutes.

So if you are building or altering—and even if you are not—you should install a shower—a SPEAKMAN Shower, for the SPEAKMAN COMPANY has been identified with the plumbing industry for nearly sixty years, and has specialized in showers for twenty-five years of that time.

Upon request, booklets showing showers installed in all kinds of bathrooms will be sent promptly. Also literature quoting authorities who endorse most heartily the shower way of bathing.

SPEAKMAN COMPANY
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Imperial Tables

Grand Rapids

"Why, it's like a new room!"

exclaimed the family delightedly.

"Yes", said Mother, "what a difference those new tables make".

You too can fairly transform your living room this fall, with the new Imperial Tables. See them at your favorite furniture store—a tempting variety of smart designs, in beautifully figured woods or decorated in gay colors.

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"World's Largest Table Factory"
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Write Dept. G for our famous book, "Heirlooms of Tomorrow", filled with decorative suggestions.

With a few strokes of a pen RICHELIEU *demonstrated that the pen is mightier than the sword"*

Illustration is exact size of the $4.00 model. Made with cardinal, black or mottled holder.

SINCE Richelieu's day, Waterman's has added even more to the power of the pen, and men as great as he have selected it because of the exceptional service it always renders.

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satisfies every pen-need perfectly

Made with different sized holders to fit different sized hands, pen points that suit every style of writing, and an ink capacity that is unequaled in pens of the same size.

. . . The LIP-GUARD, the CLIP-CAP, the SPECIAL FILLING DEVICE and the SPOON-FEED are four outstanding features.

Ask any one of 50,000 merchants to show you the style illustrated; with cardinal, black or mottled holder. Make your selection at $4.00 or in larger sizes at $5.50 or $6.50.

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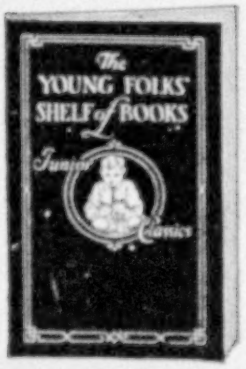

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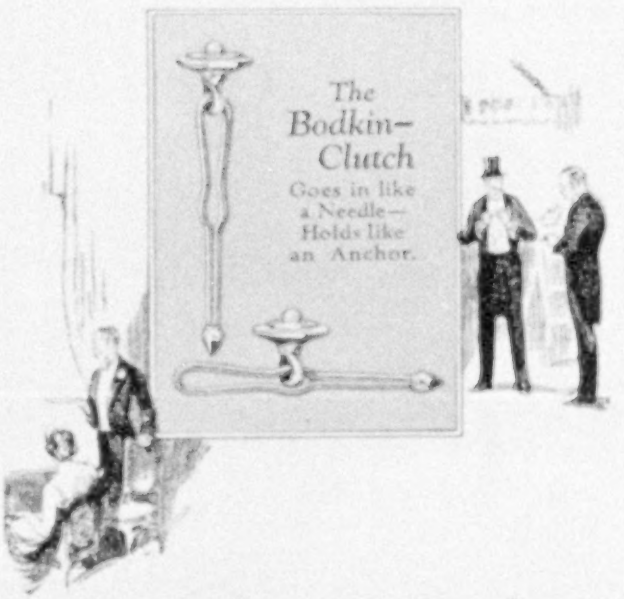

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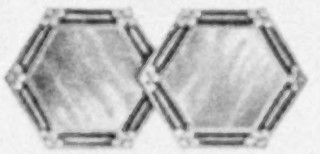

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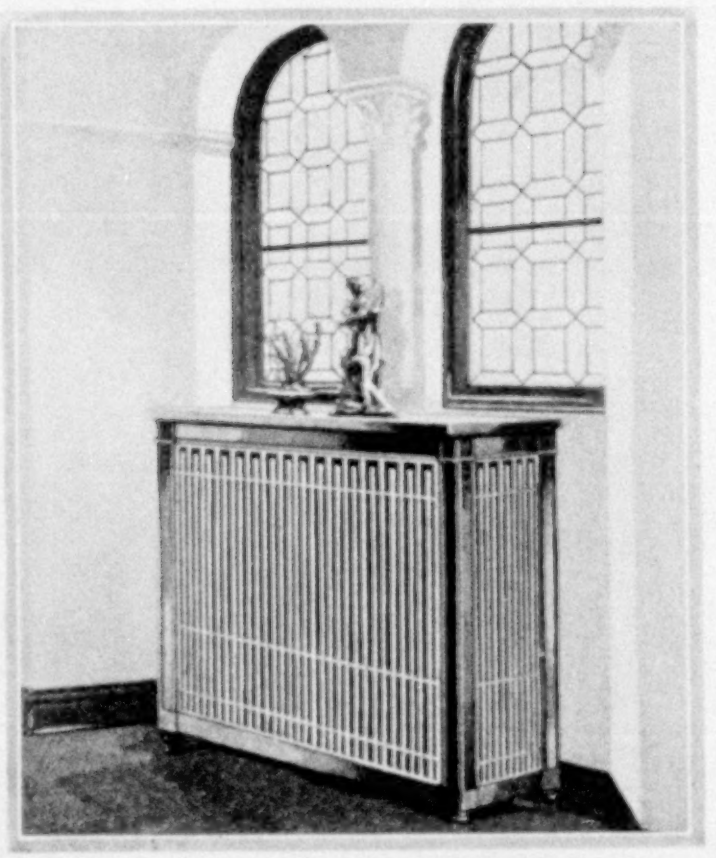

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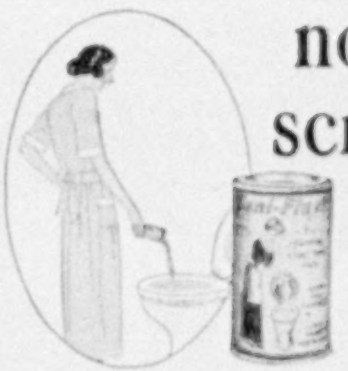

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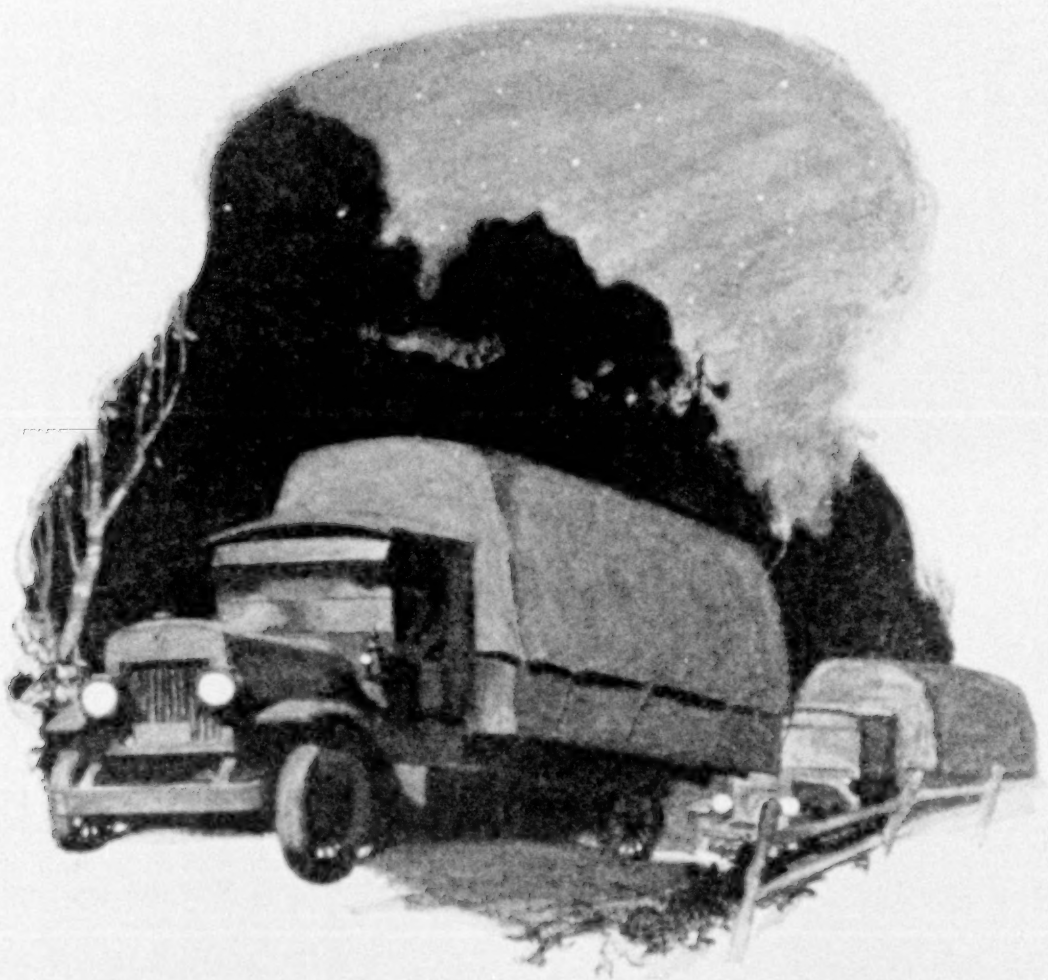

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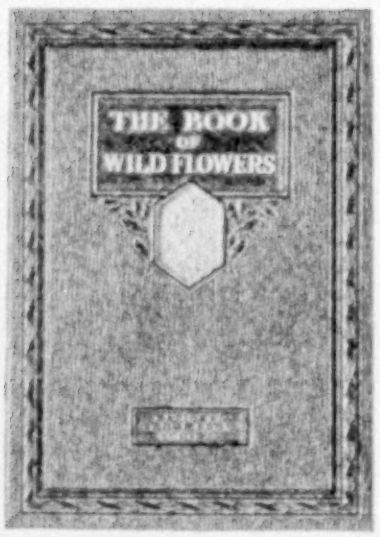

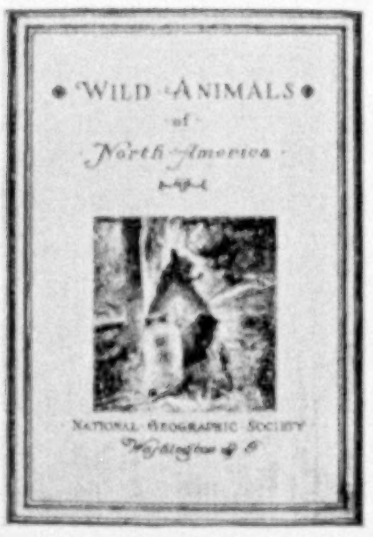

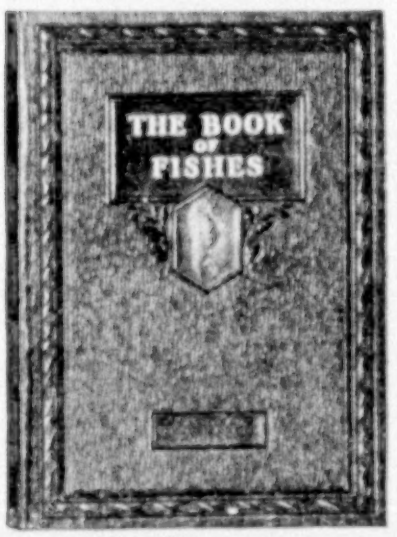

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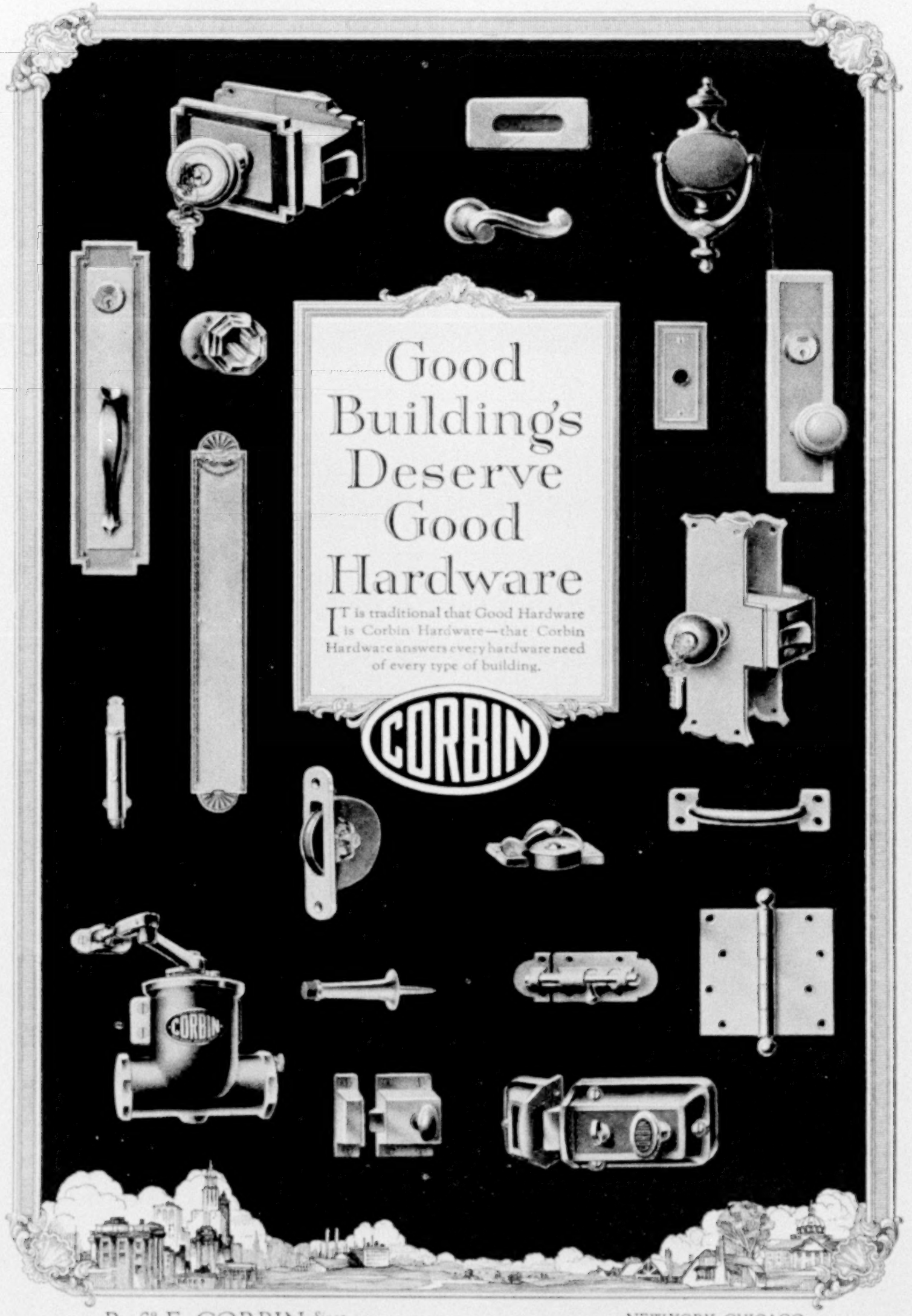

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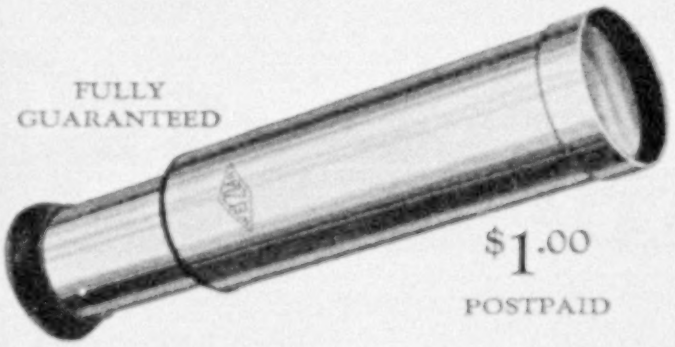

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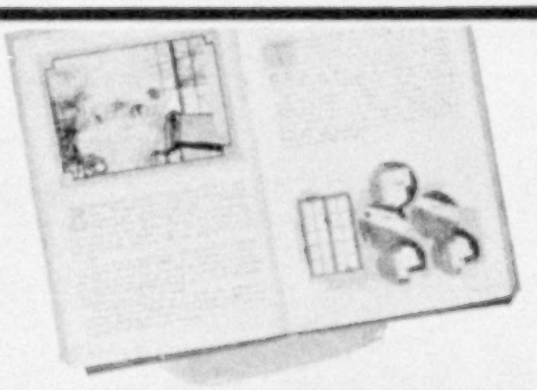

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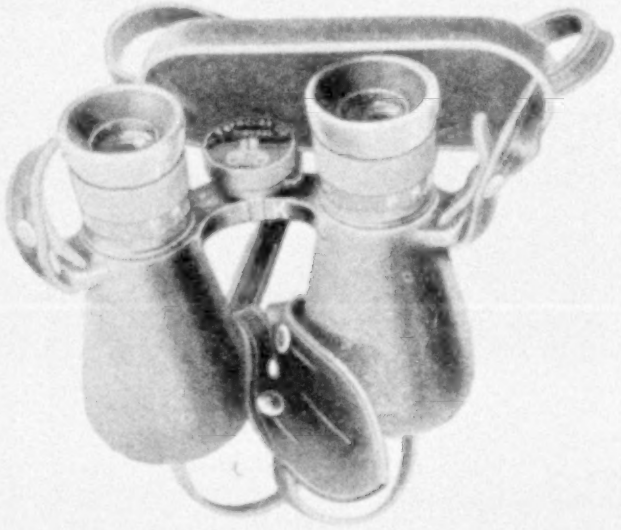

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Here is an exceptional writing instrument. Works free and easy like a pencil, but writes with ink. Banks and other institutions having manifold work find the Onoto useful and economical. Its iridio platinum point is excellent for making two and even three duplicates. Then, too, it is practically indestructible and lasts for years and years. The Onoto has a large ink capacity. Non-leaking, no matter in what position it is carried. In long or short size; black or red; $3 to $5.

It will be a pleasure to send you illustrated literature and names of Onoto dealers in your vicinity.

THOMAS DE LA RUE & CO., Ltd.
450 Fourth Ave., New York
No ink is quite so good as Onoto Ink!

Pin Up Your Favorite Pictures From Geographic

Mounted or unmounted prints are easily fastened up without injuring walls or pictures, with

Moore Push-Pins
Glass Heads—Steel Points

For the framed pictures, or any other heavy wall decorations, use

Moore Push-less Hangers
"The Hanger with the Twist"

10c. Pkts. Everywhere
Moore Push-Pin Co., Philadelphia, Pa.

CLARK'S 4 FAMOUS CRUISES
By Cunard line, new oil burners

Jan. 20, Around the World Cruise
westward; 128 days, $1250 to $3000.

Jan. 30, Mediterranean Cruise
62 days, $600 to $1700.

Feb. 4, South America with Rio
and Buenos Aires; 50 days, $550 to $1250.

June 30, 1926, Norway
and Western Mediterranean; 53 days, $550 to $1300.

Rates include hotels, drives, guides, fees. Longest experienced cruise management. Established 30 years.

F. C. CLARK . . Times Building, New York

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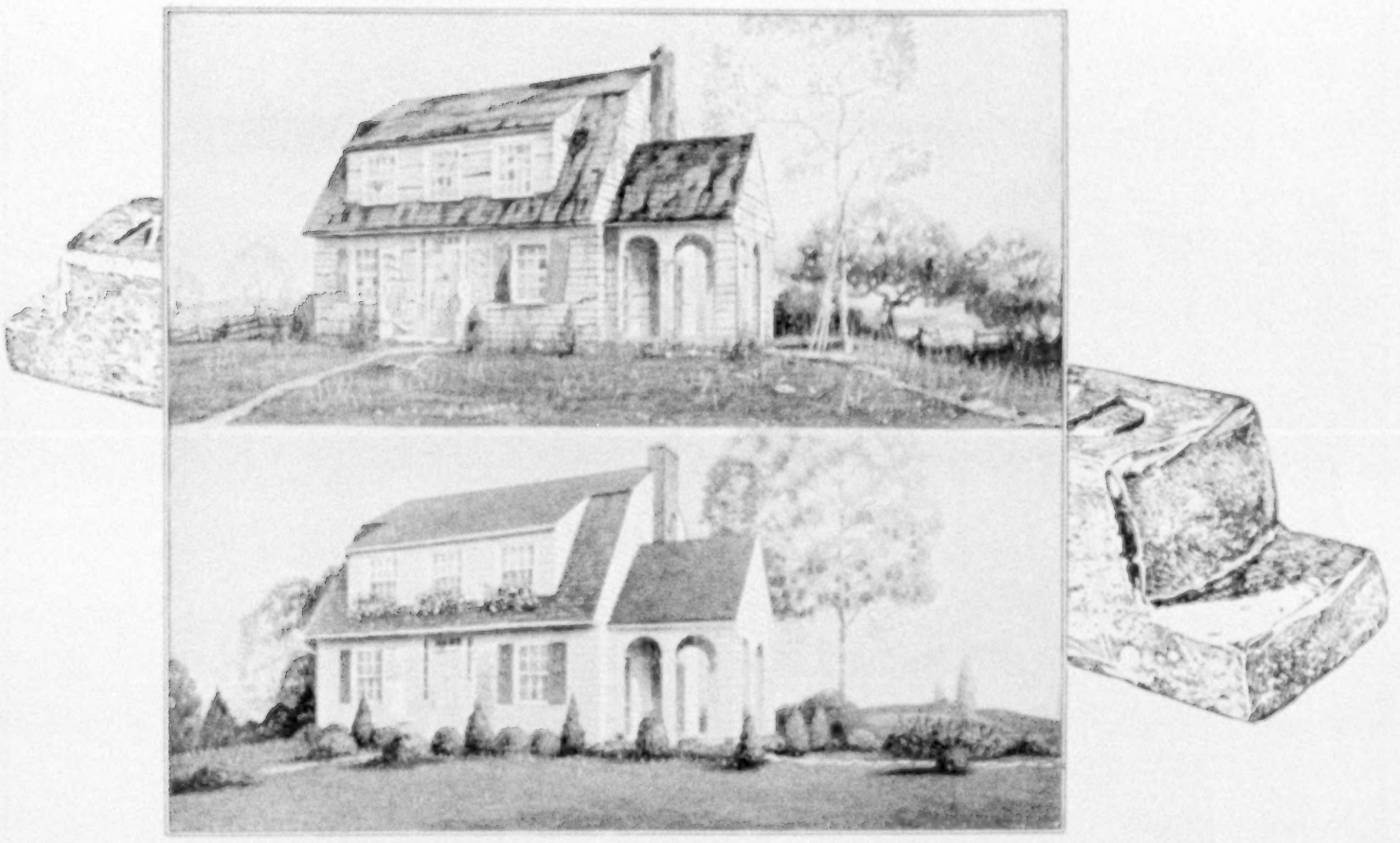


Both homes cost the same to build

Consider their value today

BOTH the homes you see here were built of the same materials. The workmanship in both was of equally high standard. The designs were identical—the costs alike.

Yet the passing years have made quite a change, a change in appearance, a change in dollars and cents. One house is ugly. Steps, window sashes, porch pillars are rotting. The entire house is in danger.

The second house still looks like new. It needs no costly repairs. It's worth every cent it originally cost, and more. What makes the difference? From year to year the surface of the second has been saved and kept beautiful by a constantly maintained film of weather-resisting white-lead paint.

Your best weather insurance

Dutch Boy white-lead is nature's true paint pigment. It is made from lead and like the metal possesses extreme durability, toughness and weather-resistance. Mixed with pure linseed oil, it makes a paint that neither force nor time's changes can separate from the surface it covers. In resisting the attacks of weather, it wears down gradually—but smoothly, with no cracking, no scaling.

A new booklet, "Painting—Protective and Decorative," tells what white-lead paint is, what it does, and why it gives complete protection to the surface. Write for it.

Other Dutch Boy products

Besides Dutch Boy white-lead, the Dutch Boy line includes flatting oil, solder, red-lead, linseed oil and babbitt metals. If you have any questions about these products or about the many uses of lead, the wonder metal, write to our nearest branch.

NATIONAL LEAD COMPANY

New York, 111 Broadway; Boston, 131 State Street; Buffalo, 116 Oak Street; Chicago, 900 West 18th Street; Cincinnati, 659 Freeman Avenue; Cleveland, 820 West Superior Avenue; St. Louis, 722 Chestnut Street; San Francisco, 485 California Street; Pittsburgh, National Lead & Oil Co., of Penna., 316 Fourth Avenue; Philadelphia, John T. Lewis & Bros. Co., 437 Chestnut Street.

THERE'S many a ship that goes to sea in a tub of Kohler Ware. And there's many a sailor lad who grows up on good terms with fresh water—and soap, too—thanks to bathrooms made inviting by those fine fixtures which bear the name "Kohler" fused in faint blue letters into snowy enamel. . . . You should have Kohler Ware in *your* bathrooms; in kitchen and laundry, too. It is distinguished ware, but no more expensive than any other that you would care to consider. Write for Booklet E.

The Vine-clad Homes of Kohler

Beautiful amid their vines and flowers, the homes of Kohler Village are as noteworthy as the quality of Kohler products —enameled plumbing ware and private electric plants

Kohler Co., *Founded 1873*, Kohler, Wisconsin
Shipping Point, Sheboygan, Wisconsin

BRANCHES IN PRINCIPAL CITIES

KOHLER OF KOHLER

Enameled Plumbing Ware

Then he saw it from *her* point of view

It was often a source of wonder to him, how she managed to accomplish so much. But he never knew the cost to her in effort, in time, in the freedom which a man has—and a woman wants. Until, one day, it was all made clear to him. She had found dirt in rugs which *should* have been clean. She had discovered that they must be *beaten*, regularly, frequently. (You, too, can prove this* . . .) And she realized how powerless she was, with the utensils provided her. Distressed, discouraged, she told him of *her* need for aids akin to those which contributed to *his* success. And then he saw it from *her* point of view! The result? A Hoover, of course. For what other electric cleaner do you know of that *BEATS as it Sweeps, as it Cleans?* Also, Hoover remarkable dusting tools fill every "dusting" need. All he paid down was $6.25. The balance was distributed into easy monthly payments. You can purchase a Hoover on the same plan. See your Authorized Hoover Dealer.

The HOOVER

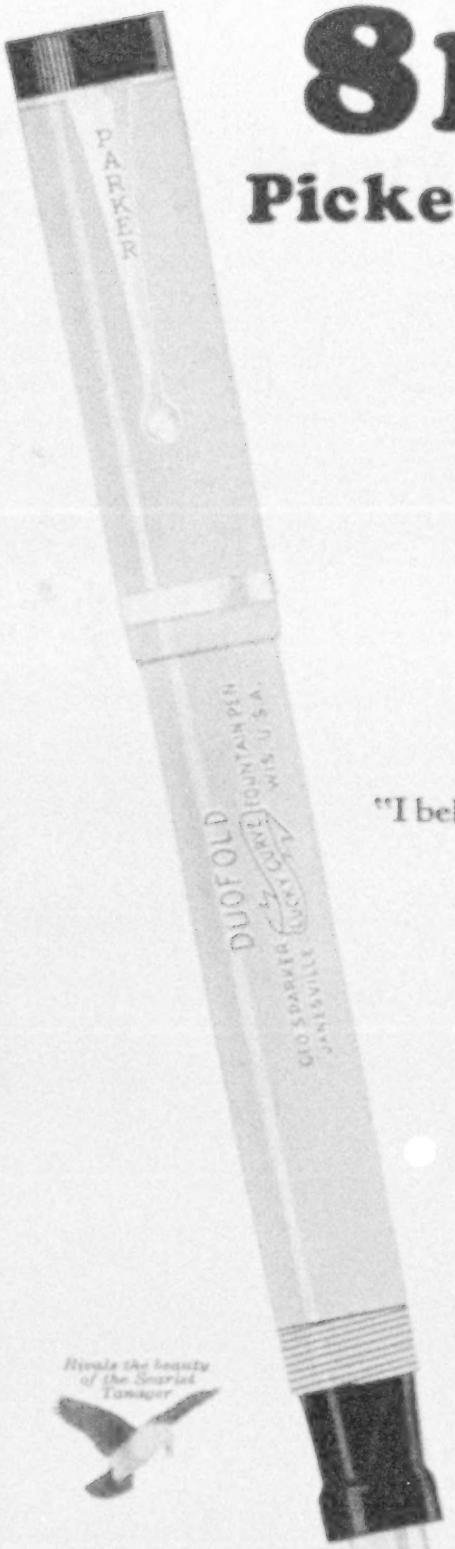
It BEATS ··· as it Sweeps as it Cleans

*TO PROVE RUGS NEED BEATING: Turn over a corner of a rug; with the handle of an ordinary table-knife, or something of equal weight, give the under or warp side 15 to 25 sharp *taps* and watch the dirt dance out from the nap depths onto a piece of paper. Feel the destructive character of this grit. This is the dirt your present cleaning methods have missed, *and that beating has dislodged.* Correct use of The Hoover causes this embedded dirt to be *vibrated* to the surface by the rapid, gentle *beating* of the Hoover brush, as powerful suction *lifts* the rug from the floor and draws all the beaten-out, swept-up dirt into the dust-tight bag

THE HOOVER COMPANY, NORTH CANTON, OHIO

The oldest and largest maker of electric cleaners · The Hoover is also made in Canada, at Hamilton, Ontario

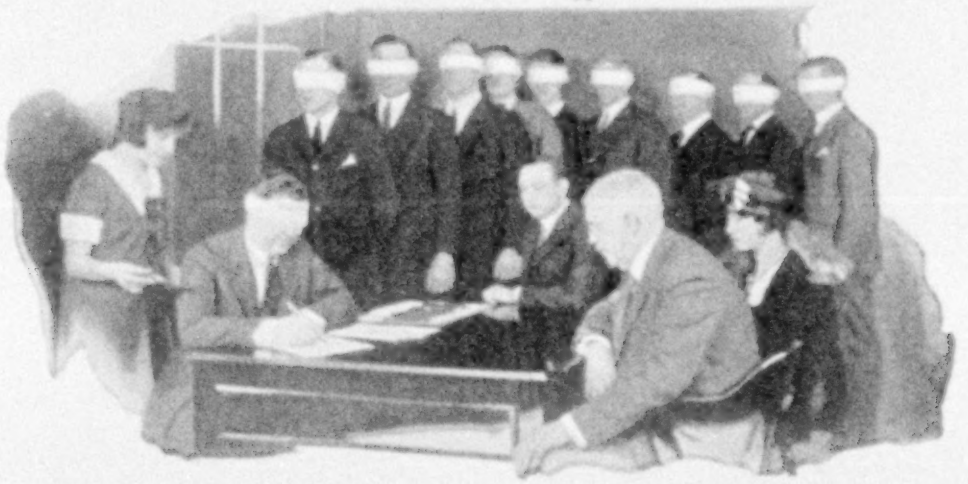
PRESS OF JUDD & DETWEILER, INC.
WASHINGTON, D. C.



8 Men out of 10

Picked the Duofold Blindfolded

From 11 New Pens of Different Makes



"I believe that the hand can tell this super-smooth writer sight unseen," declared a Duofold owner—and he proved it!

YES, ten men, chosen at random, agreed to make this test and were blindfolded. One by one, in the presence of several witnesses, they were handed 11 large new pens of different makes, obtained from pen dealers' stocks.

Each man wrote with all 11 pens on an ordinary note pad. And one by one he laid them all aside until only a single pen remained in his hand—the pen he ranked as the smoothest, most inspiring writer.

Then the blindfold was removed. And man after man, with but two exceptions, glanced down to behold in his hand the flashing black-tipped lacquer-red Parker Duofold, with the point guaranteed, if not misused, for 25 years.

Never before a pen selection so unbiased as this. No one behind a counter to urge this pen or that. Not even the Duofold's famed name or handsome color visible, to sway the hand's Simon-pure judgment.

You, too, can tell this super-smooth point with your eyes shut. Step to the nearest pen counter now and try it.

Choose Your Point

Extra fine
Fine
Medium
Broad
Stub
Oblique

THE PARKER PEN COMPANY, JANESVILLE, WIS.

NEW YORK • CHICAGO *Duofold Pencils to match the pens* SAN FRANCISCO
Lady, $3; Over-size Jr., $3.50; "Big Brother" Over-size, $4

THE PARKER FOUNTAIN PEN COMPANY, LIMITED, TORONTO, CANADA
THE PARKER PEN CO., LIMITED, 2 AND 3 NORFOLK ST., STRAND, LONDON, ENGLAND

Parker Duofold LUCKY CURVE OVER-SIZE **$7**

With The 25 Year Point

Red and Black Color Combination Reg. Trade Mark U. S. Pat. Office

Duofold Jr. $5 Intermediate Size

Lady Duofold $5 With ring for chatelaine